

Para.	Subject.	Page.
CHAPTER IV—CONTINUED.		
PRINCIPLES OF ASSESSMENTS—continued.		
92	Share of the profits due to the State and the Zamindars ...	65
93	Departure from the general principle in chauth and istamari villages ...	66
94	Method of working in regard to assessment ...	66
95	Similarity of methods in Alwar and Bharatpur ...	67
96	Summary of the estimates employed as a guide to the new assessment ...	67
97	Relative utility of these estimates ...	68
98	Discussion of the cash rent rates available ...	68
99	Necessity for discrimination in the rent rates ...	69
100	Method of ascertaining the value of the produce in an average year ...	69
101	Prices ...	69
102	Extent to which prices have risen since last settlement ...	70
103	Rates of yield ...	70
104	Deductions for failure of crops... ..	71
105	Deduction for fodder crops ...	71
106	Deduction for menials' dues ...	71
106A	State share at one-fourth of the produce ...	72
107	Statistics of cultivating occupancy ...	72
108	Small area under rents in kind ...	72
109	Owner's share of the produce and its value in cash ...	72
110	Net assets and revenue rates per bigha by the cultivation ...	73
111	Remarks on cash rents ...	73
112	Special enquiry to elicit genuine cash rents ...	73
113	Comparison with Alwar and adjoining British districts ...	74
114	Other assets taken account of in the assessment ...	75
115	Special measures adopted for leasing surplus waste ...	75
116	Proposals now made for the grant of leases on favourable terms ...	75
117	Working of the system ...	76
118	Statistics of progress up to date in breaking up waste... ..	76
119	Abolition of miscellaneous cesses ...	78
120	Items of the new demand ...	78

Para.	Subject.	Page.
CHAPTER IV—CONCLUDED.		
PRINCIPLES OF ASSESSMENTS— <i>concluded</i> ,		
121	Assessment of sairaba lands	78
122	Principles now laid down	79
123	Malba	80
CHAPTER V.		
RESULT OF RE-ASSESSMENT.		
124	Summary of considerations for and against enhancement ...	81
125	Old and new demand by tahsils and estimates for fixing the latter	82
126	New and old demand for the present tahsils	83
127	Total enhancement owing to re-assessment	86
128	Village assessments	86
129	Announcement to, and acceptance of the assessment by, each circle	86
129A	General remarks on the pitch of new assessment	87
130	Dates of revenue instalments	87
131	Amonnts payable in kharif and rabi	88
132	Measures to be taken to prevent overrealisation	88
CHAPTER VI.		
133	Former and present methods of distribution	89
134	Evils of the former system	89
135	Inequality of distribution by sharos	89
136	Difficulties in getting the distribution and final result ...	90
137	Progressive assessment	90
138	Area on which jama is distributed	91
139	Bachh in case of sairaba lands	91
140	Comparison of annual settlement bachh	91
141	Distribution of tenants	92
142	Responsibilities of owners	92
CHAPTER VII.		
REVENUE ASSIGNMENTS.		
143	Mafi area	93
144	Kinds of mafi	95
145	Records of mafi grants	95

Para.	Subject.	Page.
	CHAPTER VII—CONCLUDED.	
	REVENUE ASSIGNMENTS.— <i>concluded.</i>	
146	Rules laid down for the general investigation ...	96
147	Rules as regards succession to revenue-free grants ...	96
148	Progress in the enquiry up to date ...	97
149	Assessment of the lands ...	97
150	Summary of the system now adopted ...	99
151	Assessment of chaauth assessment in Dig ...	99
152	Nankar ...	99
153	Preparation of mañ registers ...	101
154	The continuance of the registers up to date ...	101
155	Points still awaiting decision ...	101
	CHAPTER VIII.	
	MISCELLANEOUS.	
156	Relation of landlord and tenants ...	102
157	Definition and record of occupancy rights ...	102
158	Status of occupancy-tenants ...	102
158A	Number of claims decided and area held by occupancy-tenants ...	103
159	Diluvion and alluvion ...	105
160	Old lambardari system ...	105
161	Reform of the lambardari system ...	105
162	Statistics of Lambardars by tahsils ...	106
163	General remarks on the revenue machinery :—	107
	(a) Deputy Collectors ...	107
	(b) Tahsildars ...	107
	(c) Naib-Tahsildars ...	107
164	Maintenance of revenue system... ..	108
165	Notice of officers ...	108
166	Income and expenditure of the settlement... ..	109
167	Conclusion ...	109
	APPENDICES.	
	APPENDIX A ...	i
	APPENDIX B ...	ii—iii
	APPENDIX C ...	iv—v
	APPENDIX D ...	vi—vii

FINAL REPORT

ON THE

SETTLEMENT OF THE BHARATPUR STATE.

CHAPTER I.

1. The history of previous assessments and the circumstances which led up to this—the first Regular Settlement of the Bharatpur State—have been mentioned in detail in the introduction to my Report of 1898 on the northern Tahsils, and will be further noticed in the course of the present report. The operations now brought to a close may be said to have begun on 5th November 1896, when Mr. E. G. Colvin, C.S., took up the office of Settlement Commissioner of the Alwar and Bharatpur States. In the ensuing cold weather he started the preparation of the preliminary record in the four northern tahsils. Under the instructions of the Government of India, the local Patwari and Kanungo agency was utilised as far as possible. A small supervising establishment of two Sadar Munsarims and sixteen Munsarims was imported from Bengal and the North-West Provinces, and this was placed under the immediate control of Mr. A. H. Pyster, who had been engaged on survey settlement work in Bihar and Orissa, and was appointed as Mr. Colvin's Assistant in January 1897.

2. During the cold weather of 1896-97 the old maps were brought up to date in 381 out of the 479 villages in the northern tahsils, and the field books or *khasras* were generally written up. The progress made is shown in Mr. Colvin's letter No. 299-C., dated 28th April 1897, an enclosure to the Agent to the Governor-General's letter No. 1955-G., dated 15th May 1897, to the Government of India.

During the hot weather the Patwaris were collected at head-quarters for the completion of the *khasras* and the correction of areas, those shown in the maps of 1889-90 being compared with those obtained by extraction with the *bigha* comb. An attempt was also made to prepare *khataunis* and genealogical trees—a work which should have preceded rather than followed the preparation of the *khasras*; but owing to the ignorance of the Patwaris and the inadequacy or inefficiency of the supervising establishment—most of whom were drawn from Bengal settlements, and were therefore unable to understand the systems of tenure prevailing and the forms of record required in the village communities of Northern India—little progress was made in this direction; and the work, which was of a preliminary nature, had to be done over again in the following cold weather.

At the end of April 1897 Mr. Colvin was appointed Political Agent, Eastern States, Rajputana, but maintained a general control over the settlement till his transfer to Baluchistan in November.

3. On 9th July 1897 I took immediate charge of the operations. In consultation with Mr. Colvin, it was decided in the cold weather of 1897-98 to complete and attest the imperfect preliminary record of the four northern tahsils, and at the same time to bring under settlement the four central tahsils. A set of Patwari rules, drafted by Mr. Colvin, was finally passed and issued and new rules for the preparation and attestation of the record were framed. It was further decided to abandon the system of making a rough preliminary record in one year, correcting and attesting it in the next, and to push on the preparation and attestation of the record simultaneously.

4. To carry out this programme a considerable increase of establishment was required. Many of the Bengal and Hindustani Munsarims, who had been hurriedly got together, were quite unequal to the task of preparing the record on the lines required; and without sufficient direction and supervision this work could not be carried out by the Patwaris. Those men therefore had to be got rid of; and as the systems of tenure are similar to those of the Punjab, and the Government of India had suggested that the settlement be carried out after the Punjab model, I endeavoured to fill their places by borrowing selected settlement-trained Patwaris and Kanungos from Punjab districts or settlements. The good offices of the Deputy Commissioners of Hissar and Lahore and of the Settlement Officers of Montgomery and Dera Ghazi Khan enabled me to do this. The Patwaris were generally appointed Munsarims on Rs. 20 to Rs. 30 per mensem; the Kanungos as Sadar Munsarims on Rs. 40 to Rs. 60.

These men have in nearly all cases been given two or three years' leave from their own districts, so that, if their services were not required at the close of settlement, they could fall back upon their substantive appointments. In the twelve tahsils under settlement, 13 Sadar Munsarims and about 70 Munsarims were employed, of whom over half were men trained in Punjab settlements. These men were the backbone of the settlement and have generally done excellent work. I can safely assert that without them it would have been impossible to carry on the operations with accuracy or dispatch.

No Amins have been made use of in preparing the record. This has been done entirely by the local Patwaris, assisted and controlled by the Munsarims. As the Patwaris were generally ignorant of Urdu, a special staff of Moharrirs—from 10 to 20 in each tahsil—was employed for the preparation of the State copy of the record in Urdu.

5. As settlement operations extended, it was found necessary to also strengthen the supervising agency. Mr. Pyster, though an excellent Survey Officer and possessing a good knowledge of records, knew little about assessment, and could not be expected to supervise the work of twelve tahsils. These were therefore divided into three circles. The Dig circle—including the five tahsils of Kama, Dig, Kumher, Akheygarh, and Bhusawar—was put in charge of Munshi Hira Singh, an experienced Settlement Tahsildar from the Punjab, whose services on an initial salary of Rs. 200 per mensem were obtained through the Government of India. The Gopalgarh circle—including the four tahsils of Pahari, Gopalgarh, Bharatpur, and Nagar—was put under Munshi Mahmud Hosain, the State Deputy Collector, who had considerable experience of settlement work in Punjab districts and in Jhallawar. The three southern tahsils of Rupbas, Oochain, and Biyana were put under Mr. Pyster, who also exercised a general control over the central office at Bharatpur, including accounts, tracing establishment, survey equipment, stationery, etc.

6. In the Introduction to the Report of 1898 I explained the lines on which I proposed to carry on the settlement, gave a rough forecast of the probable results of re-assessment, and sketched the programme of work. There were then twelve tahsils in the State, and my proposal was to frame proposals for and re-assess the four northern tahsils—Gopalgarh, Pahari, Kama, and Dig—in the hot weather and autumn of 1898; the four central tahsils—Nagar, Kumher, Akheygarh, and Bharatpur—in the corresponding period of 1899; and the four southern tahsils—Rupbas, Oochain, Biyana, and Bhusawar—in the corresponding period of 1900, thus closing the operations—unless delayed by unforeseen contingencies—in the spring of 1901. I am happy to say that in Bharatpur, as in Alwar, I have been able to carry out my programme almost to the letter. The only departure from it had been that the new assessments of the four northern tahsils, though completed in 1898, were not, owing to the bad harvests in 1898-99, brought into working till the autumn of 1899, at the same time as those of the central tahsils. The progress made in re-assessment has been fully reported in my printed Reports of 1898, 1899, and 1900, dealing respectively with the assessments of the

northern, central, and southern tahsils, while the action taken towards (1) preparing a complete record-of-rights for the first time, (2) reorganising the Patwari and Kanungo agency so as to ensure that the record is kept up to date after the settlement has been completed, is described in the annual reports submitted to the Political Agent and Council. These reports may be referred to for any points which may have escaped my memory in this hurried attempt to give a succinct and connected account of the operations as a whole. All branches of the work have now been disposed of completely, except that (1) a considerable number of *maji* cases are still pending, which will, I hope, be disposed of by the State Council; (2) a Revenue Manual or set of rules for the future working of the revenue administration is under preparation; but this will, I hope, be completed by 1st April and sent to the Political Agent and Council for approval.

7. This report is primarily intended to be a description of the settle-

Object and contents of the present report. ment operations and their results, but I shall also endeavour to touch on all points in the Revenue administration which will require the special vigilance of the Darbar hereafter. As in my Alwar Report, the subject is dealt with under the following heads, to each of which a separate chapter is devoted :—

- I.—Introductory and descriptive.
- II.—Political and Revenue history.
- III.—Survey and Records.
- IV.—Principles and procedure in re-assessment.
- V.—Results of re-assessment.
- VI.—Distribution of the assessment over holdings.
- VII.—Revenue assignments.
- VIII.—Miscellaneous—
 - (a) landlord and tenant;
 - (b) *lambardari* system;
 - (c) other matters;
 - (d) income and expenditure of the settlement.

Of these, I, II, IV and V have been discussed in detail in the assessment report for each tahsil or group of tahsils, and I shall therefore confine myself to a brief survey of the results for the State as a whole. The remaining subjects have been also incidentally dealt with in the assessment and annual reports, and I shall aim at giving a more comprehensive explanation of them. As I have only ten days at my disposal, any omissions or imperfections will, I trust, be treated with indulgence.

8. The Jat State of Bharatpur is situated in the extreme north-east of the Rajputana Agency, and is bounded on the north by the Gurgaon district of the Punjab, on the east by the Mattra and Agra Districts of the North-West Provinces, on the south by the Rajputana States of Jaipur and Karaoli and the Jat State of Dholpur, on the south-west by Jaipur, and on the west by the Rajput State of Alwar. It lies between latitudes $26^{\circ} 43''$ and $27^{\circ} 50''$ and longitudes $76^{\circ} 54''$ and $77^{\circ} 59''$. The greatest length is 76 and the greatest breadth 48 miles, while the total area, according to the revenue survey of 1855–58, is 1,974.07 square miles, and by the village maps 1,993 square miles. The local standard of measurement is the *bigha*, which is equal to $\frac{2}{3}$ of an acre, and all the assessment statistics are based on that standard. Since the revenue survey the area may have varied slightly owing to exchange of five Bharatpur villages with five Alwar villages in 1885. In shape Bharatpur is a very irregular quadrilateral, narrowing from south to north, with spurs projecting out into Alwar on the west, Dholpur on the south, and Agra on the east. There are also some isolated villages in the Agra and Mattra districts.

9. The State is divided into the two *Nizamats* or districts of Dig and Bharatpur,—roughly northern and southern,—each containing six tahsils, but for assessment purposes it is more convenient to follow the natural geographical division, which is as follows :—

- Administrative and natural divisions.
- Northern—Gopalgarh, Pahari, Kama, and Dig.
 - Central—Nagar, Akheygarh, Kumher, and Bharatpur.
 - Southern—Bhusawar, Biyana, Oochain, and Rupbas.

There were formerly fourteen tahsils, but the number was reduced to twelve some years ago by the inclusion of Weir in Bhusawar, which also contains the *jagir* of Ballabgarh, and of Rudawal in Gochain. During the settlement the Gopalgarh and Gochain tahsils have been dismembered—the former being divided among Nagar and Pahari, the latter among Rupbas and Akheygarh. Several other minor changes have also been made to rectify tahsil boundaries; the headquarters of the Bhusawar tahsil have been changed to Weir; and there are now only ten tahsils, which may be thus classified—

Northern—Nagar, Pahari, Kama, and Dig.

Central—Akheygarh, Kumher, and Bharatpur.

Southern—Bhusawar (now Weir), Biyana, and Rupbas.

The assessment reports follow the old division into twelve; this report the new arrangement into ten tahsils. Hence it has been necessary to re-cast all the statistics to make them applicable to present conditions. The central tahsils are level, the northern are to some extent, and the southern considerably diversified by hills. All parts are liable to sudden inundations from torrential rivers, *viz.*, the Ruparel from Alwar, and the Banganga with its tributaries—the Gambhir and Kakund—from Jaipur, running east towards the Jamna. In this lies the main difference between Bharatpur and the adjoining British districts of Gurgaon, Agra, and Mattrā, with which, as regards soil, climate, and agricultural conditions, it has much more in common than with any portion of Rajputana, except perhaps Alwar. The general aspect is that of an immense alluvial plain, fairly wooded and cultivated, with detached hills on the north, a hilly and broken district on the south, and low narrow ranges on some parts of the western and north-eastern frontier. The highest elevations are :—

Alipur in Dig 1,357 feet (above sea level) ;

Chapra in Pahari 1,222 feet ;

Damdama in Biyana 1,222 feet ;

Rasiya between Dig and Naga 1,065 feet.

10. The State is exceptionally well served in the matter of communications. The central tahsils of Akheygarh and Bharatpur are intersected by the Bandikui-Agra Branch of the Rajputana-Malwa Railway, which traverses the State from east to west for a distance of nearly 40 miles, and has four railway stations, *viz.*, Nadbai in Akheygarh, Heylak in Kumher, and Bharatpur and Ikran in Bharatpur.

There are besides—

- (1) 129 miles of 1st class metalled roads ;
- (2) 64 " 2nd " unmetalled roads, raised and partly bridged ;
- (3) 173 " 3rd " roads aligned surface tracks ;

and the mileage of (1) and (2) is being steadily increased.

11. Details of the total and cultivated area of each tahsil for (a) the year of settlement (1897-98 in the northern and central tahsils, and 1898-99 in the southern) and (b) the present year 1900-1901, together with crop statistics to correspond, are given in the appendices. The following statement contains a useful summary of statistics of area, cultivation in year of settlement, land revenue (former and as now fixed), and population in 1901 :—

Leading statistics of area and jama.

"Bharatpur forms part of the alluvial basin of the Ganges and Jamna, consequently the great majority of the exposed rocks are alluvial, consisting of modern alluvial deposit with blown sand, which the wind carries from the desert of Rajputana, and occasionally forms into mounds on the leeward of some natural inequality in the surface. It might be said of the greater part of Bharatpur what Sidney Smith said of Holland: 'It is the place of eternal punishment of geologists, all mud and no stone by substituting "clay" for "mud"'. The soil is of considerable depth, though the *burrow* is shallow, owing to the imperfect system of tillage, and has alterations of thin strata of sand and sandy impermeable clay, and beneath are ancient alluvial deposits with fresh-water shells of the *mollusca*, and occasionally *kankar* (nodular masses of impure calcine carbonate) and clay, shale and laterite.

(1) Alluvial. "The Vindhyan occurs in the range which runs from Fatehpur Sikri towards Hindann. The range belongs to the Upper Vindhyan division, and two of its sub-divisions—the Bhanver and Riwa—are represented, the former extensively.

"The main range is formed of Upper Bhanvers, consisting almost entirely of sandstone of various texture and colour, varying from a very fine rock to almost conglomerate. The prevailing colour is brick-red, with white spots or streaks, sometimes green and yellowish white, occurring sometimes in alternate beds of considerable thickness. The ridge, which runs parallel with, and to the west of, the above range in pargana Rudawal, is probably formed of Riwa: this appears likely both from the character of the stone and the dip of the strata—the general characteristics of the Riwa being coarse greyish white, while those of Bhanver are fine red, speckled or streaked with white. In some places these differences are well marked; in others they merge into each other. The ridge consists of sandstone in massive strata and false-bedded flags, usually hard and compact, occasionally vitrified, and reddish or yellowish in colour. In some places, thick chaly bed, mostly quartz or siliceous, but sometimes clay, are found. Some specimens of the sandstone approach to conglomerate, the pebbles being quartz or red jasper and the matrix purple. Other specimens are more like breccia.

"The hills west of Biyana, and divided from the Sidgirpahar by the catchment basin of the Gambhir river, are formed of quartzite sandstone interstratified with trap and shale. All the hills in the north and west are of the same character, with limestone, hornstone, transition slate, siliceous beds, schists, and ferruginous conglomerates.

(3) Hill ranges. "The principal hills are a low range forming the boundary between parganas Pahari and Gopalgarh of Bharatpur, and Perozepore and Alwar, for about 20 miles, the highest point of which (Chapra) is 1,222 feet high. Its general direction is from north to south.

"The Kalapahar, in Akheygarh pargana, close to the Alwar frontier, contains the highest summit in Bharatpur, viz., Alipur, 1,351 feet high. The Sidgirpahar range runs on the south-eastern frontier between the parganas of Rupbas and Biyana of Bharatpur, and Sarehndi of Agra. The general direction is from north-east to south-west, and the length about 30 miles; the highest point is Udera, 817 feet. In it are situated the celebrated Bansi Paharpur stone quarries. The range becomes broken in the southern part of Biyana into irregular branches, which help to form the district called the Dang—a tract completely broken up with ravines, very difficult of access, and covered with jungle—the highest portions forming a plateau. North-west and parallel to this is an interrupted range running through Rudawal to the south of Biyana, which by its southern extremity helps also to form the Dang.

"The other hills in the south consist of two broken, irregular ranges, running generally in a parallel direction, with several offshoots through the parganas of Weir and Biyana from north-west to south-east. The highest point is Dandanna, 1,215 feet. These are separated from the Sidgirpahar range by the Gambhir river. The old fort of Biyana is situated on one of them. In the north there are several groups of detached hills, which form an interrupted chain in Kaman, Gopalgarh and Dig, terminating in Nagar by the Rasia peak, 1,059 feet high. Between Kaman and Mattra is another low range, which is continued into Dig. Its general direction is from north-east to south-west, and its greatest elevation at Manpur, 826 feet, in the Mattra district.

"About three miles distant from Bharatpur is a ridge running from north-east to south-west, about three miles long; the highest point is Madhoni, 714 feet high—a position with sufficient altitude to command the city with modern artillery.

"The State is poor in this respect. Copper is found in the hills in Biyana and Weir, and these mines were worked in former times, but given up, as they were found not to pay for the working. Iron is also found near Jahaj in Biyana, but the mines are not worked. No precious stones are found. Brick-clay, kankar, etc. abound, but the quarries only require to be noticed.

Mineral products.

"The stone from the south of Bharatpur, known geologically as Upper Bhanver sandstone, has furnished materials for the most celebrated monuments of the Moghul dynasty at Agra, Delhi, and Fatehpur Sikri ; it has also supplied Mattra, Dig, Bharatpur, etc. The quarries of Bansi Paharpur in Rupbas are the most celebrated. The stone is of two varieties—one dark red, generally speckled with yellowish-white spots ; sometimes the white is in streaks or large irregular patches. The other is yellowish-white, homogeneous both in colour and texture, and very fine-grained. These varieties are usually found in separate quarries. The red variety is inferior for architectural purposes to the white, owing to the irregularity of its colouring (this defect is evident in the Taj, where the effect is marred in consequence), also to the liability of some specimens to disintegration from the effects of time, though others retain after three hundred years their carving almost as sharp as when fresh from the chisel : examples of both may be seen in Akhbar's palace at Fatehpur Sikri. The palace of Beeral's daughter is the best specimen of this stone. The red variety is remarkable for perfect parallel lamination, on account of which, by the introduction of a series of wedges, it readily splits into suitable flags, which are much used for roofs and floors ; but this quality diminishes its value in other respects.

"The yellowish-white variety is remarkable for its fineness and uniformity of texture, allowing delicate and elaborate work, while, owing to the thickness of many of the bed in which it is found, it can be procured of great size : it is also uniform in its colour. The palaces at Dig, which are considered some of the most beautiful in India, testify to the excellence of this stone. The palace, the temple, and other structures in Bharatpur are also built of it, and the cenotaphs of the Bharatpur Maharajas at Gobardhan.

"Climate may be defined as the sum of the influences of the sun on the water and soil of a place affecting health, and certain conditions of each of those factors are such in Bharatpur as to affect it unfavourably. The chief of these conditions are the following :—The mean temperature is shown to be very high, especially taking into consideration the considerable annual fluctuation, and its being subject to undulations. The air, with regard to humidity, has a tendency to extremes, and is impure from malaria. The quality of the water is generally very inferior, containing much saline impurities, principally sodium salts, also those of calcium, magnesium, with occasional iron and silica, and often much organic matter : the solids in a gallon vary from 20 to 120 grains. The conformation and elevation of the soil are unfavourable, it being flat and low, while owing to its mechanical structure the absorption of heat is great and the radiation slow, especially as there is little herbage ; and its chemical composition affects the water and produces malaria. A considerable area of Bharatpur exactly represents one type of a malarious country—a low-lying, alluvial soil, with strata of sandy impermeable clay, or sand with an impermeable clay sub-soil, organic impurities, a high temperature, and an annual inundation when the water neither drains off nor is absorbed. Much improvement is possible by drainage and attending to hygiene, the latter being even more needed where putrescence is so favoured by the high temperature and humidity in and after the rainy season, when a great percentage of the population suffers from fevers, which are followed by their usual train of effects in other seasons."

16. The natural features which have most influence on agriculture are
 Irrigation from natural sources. (1) the hills already described—the drainage from which fertilises an area of nearly 50,000 *bighas*, known as *sairaba barishi*, chiefly in the northern tahsils, and (2) the torrential streams which have been trained or dammed so as to inundate with more or less regularity an area of nearly 300,000 *bighas* of cultivation, in which *rabi* crops—gram alone, or mixed with wheat and barley, oil-seeds, etc.—are generally sown. The land usually flooded and actually inundated in the year of attestation has been classed as *sairaba hal* ; that occasionally flooded, but not in the year of attestation, is recorded as *sairaba sabika*.

The two great sources of these annual inundations are—

- (1) the Ruparel from Alwar in the northern tahsils ;
- (2) the Banganga and its tributaries, the Gambhir and Kakuind from Jaipur, and Karauli, which are of enormous benefit to the three southern tahsils, as well as to Bharatpur and part of Akheygarh.

The only tahsil which benefits from neither source is Kumher, which has practically no *sairaba* cultivation.

Bharatpur is thus in the fortunate position of deriving immense advantages from the inundations of streams, the catchment areas of which lie

chiefly in other States. The position is a delicate one, and the admitted vested rights of Bharatpur in both the Ruparel and the Banganga have been the subject of long and acute controversy with Alwar and Jaipur respectively. The history of these discussions has been given at length in my assessment reports, which should be referred to for details. Both streams are dependent on the rains for their supply.

17. The Ruparel has an excellent catchment of nearly 500 square miles in Alwar. It is fed by springs at its source and here and there along its course, but the flow is inconsiderable, except during and for some time after the monsoon rains, and in places it dries up altogether during the rainless months. Alwar and Bharatpur are supposed to share equally in the irrigation; but it has been finally ruled that Alwar should receive its equivalent from (1) the Siliserh *band* near Alwar city, which intercepts part of the catchment drainage, and (2) the right to erect temporary dams in the stream during the eight rainless months (10th October to 9th June); while Bharatpur has the right to the unrestricted flow during the monsoon period (10th June to 9th October) in each year. The area inundated in Bharatpur varies from 50,000 to 80,000 *bighas* annually, according to the rainfall in the Alwar hills. The floods are distributed by the great Sikri *band* in the Nagar tahsil—14 miles long—and a number of subsidiary retaining and distributing works. The Nagar tahsil and the south of Pahari are chiefly benefited, but if the floods are exceptionally high they penetrate by an old channel to the north of Pahari and to Kama, and by a more recent channel through the Kakra *band* to Dig city, whence a canal was cut by Lieut. Home, R. E., in 1866-67, to bring them through Kumher to the Moti jhil *band* near Bharatpur city.

18. The Banganga is in flow only during the monsoon months. Before reaching Bharatpur it has a catchment area of 1,466 square miles—401 in Alwar and 1,065 in Jaipur—chiefly in hilly country. This does not include the catchment area of 324 miles west of the Ramgarh dam in Jaipur, which that State was allowed to utilise in 1897, on the distinct understanding however that Bharatpur should be entitled to submit to the final arbitration of the Agent to the Governor-General its claims to compensation for damage (if any) actually caused by the work. The dam has, I believe, now been constructed, and its effect on the Banganga floods in Bharatpur should be carefully watched, as the latter State is now in a position to utilise all the Banganga supply.

The Banganga floods were formerly, owing to the neglect of the old irrigation works by the late Maharaja, the cause of widespread ruin and agricultural depression, not only along the course of the stream in Bharatpur, but also further west in the Agra district; and the remonstrances of the Government of the North-Western Provinces led to the appointment of Mr. J. A. Devenish as Executive Engineer in 1895, with the primary object of controlling them. Since then there have been no further complaints of damage from Agra, chiefly because the irrigation works undertaken for the proper distribution of the floods have caused them to be freely utilised in Bharatpur, and converted them from a curse into a blessing. Mr. Devenish writes on this subject:—

“The conditions now are that we use nearly all, if not all, of the floods of the Banganga river. It is possible that in an exceptionally heavy flood a small proportion of the water finds its way beyond the Bharatpur borders. We use certainly all the water of moderate and light floods for irrigation. This use of the water has been effected by the restoration of old works and by the construction of new channels and tanks.”

In 1898-99 about 60,000 *bighas* were irrigated by such works from the Banganga alone. In the present year, owing to the action taken for breaking up the large areas of land that had become waste owing to water-logging and the ravages of the wild cattle, that area has been considerably increased. When the projects now under construction are completed, if sufficient funds are allotted for the work and the active co-operation of the Revenue authorities insisted on, the Banganga floods should irrigate from 100,000 to 125,000 *bighas* or 40,000 to 50,000 acres of excellent cultivation in average years and will become the most valuable asset the State possesses.

The Ruparel floods are very fertilising, as they never leave deposits of sand, and the land renews its vigour every year and requires no manure. The Banganga floods, on the other hand, contain sand in deposit, which is often discharged close to the channel, and in the past threw considerable areas out of cultivation. The damage from this source has however been much reduced since the inundations have been brought under control.

19. After the Ruparel and Banganga the most important stream is the Gambhir (para. 8 of Report on Southern Tahsils), which enters Biyana on the south-west from Jaipur, receives the drainage of several *nalas* from the Biyana and Rupbas hills, and runs north-east for a distance of 35 miles to Karka in Rupbas, where it formerly united with an old channel of the Banganga; but this channel no longer carries any of the Banganga floods, which are tapped further west for irrigation. From Karka the Gambhir has a further course of 25 miles due east through the State before it enters Agra. The Gambhir floods are not so extensive as those of the Banganga, but they are fertilising and very beneficial.

Beyond two cuts at Bakoli and Dalwagaon to fill some dams in the Rupbas tahsil, there are as yet no irrigation works on the Gambhir. I believe however the Executive Engineer has his eye on a suitable site for a large dam close to Biyana.

20. The Kakund stream from Karaoli is, or rather was, the chief affluent of the Gambhir. It is now most effectively dammed by the great Baretta *band* in Biyana (para. 9 of Report on Southern Tahsils), which has recently been completed at a cost of 2½ lakhs, and in 1899-1900 irrigated over 10,000 *bighas* in Biyana and Rupbas, chiefly through the sluices. In 1899 the dam filled up to escape level—45 feet above the bed—and the area submerged was 5 square miles with a cubic content of 1,500 million cubic feet.

When the channels are complete and the irrigation developed the area should expand to 25,000 *bighas* in a normal year. Nearly all this area will be irrigated by means of ducts from the reservoir, and the following crop rates have recently been fixed, which are exclusive of the land revenue assessed :—

Kharif crops per bigha.	Rabi crops per bigha.
Sugarcane, Rs. 2-8-0. Maize, cotton and zira, Rs. 2. Jawar, bajra and other kharif crops, Re. 1.	Opium, Rs. 2-8-0. Wheat, barley and zira, Rs. 2. Wheat and barley, mixed with gram, Re. 1-8-0. Gram alone, Re. 1.

Where the land irrigated from the channels has already been assessed at *chaki* rates, only half the above water-rates should be charged.

21. I am unable to find space in this report for reference to the many irrigation works which have been constructed or restored by the Executive Engineer since 1895. They have been noticed in the various assessment reports, and I understand that a comprehensive account of them has lately been prepared by Mr. Devenish, which should be separately printed. Were it not for these works the land revenue would have had to be reduced at least in the southern tahsils in the present settlement instead of being substantially enhanced; and as the remarks I made in reporting on the assessments of the southern tahsils are applicable to the State generally, I reproduce them here :—

“One of the most important questions of revenue administration in these tahsils is the efficient maintenance of the irrigation system for controlling and distributing, in a manner beneficial to the cultivators, the floods of the Banganga, Kakund, Gambhir and other torrential streams by means of the great system of irrigation dams, reservoirs, and canals which have been restored, extended, or newly constructed with remarkable success within the last 5 years by the State Engineer, Mr. J. A. Devenish. On these works the prosperity of these tahsils largely depends, and any relaxation of the system of continuous supervision and

development will at once react on the land revenue realisations. For this purpose the State will always need the services of a thoroughly competent Engineer with special knowledge of canal and dam irrigation. Besides securing the payment of the land revenue now assessed, there is also ample scope for developing the direct income from water-rates.

"In the present assessment I have noted for each estate whether the water-rate for irrigation from State works is included in or excluded from the *jama*. In many of the larger works—such as the Bareta *band*, the Lalpura *band*, and the canals from Haleyna, Pathena, etc., constructed within the last few years—the water-rate has been excluded and will be levied on the area actually inundated and sown from year to year according to the principles explained in para. 116 of my Report. Even where the water-rate has been included in the assessment, any appreciable extension of irrigation beyond the area recorded at settlement will have to pay separate water-rates. To work this system and maintain and extend the irrigation works a skilled professional agency working in close touch with the Revenue Department is absolutely necessary.

After careful calculation I have come to the conclusion that the value of this irrigation throughout the State in the re-assessment now completed is about 5 lakhs per annum or nearly one-fourth of the land-revenue, and from this I trust the Darbar will realise of what vital importance it is to the State and to the people that the irrigation system should be maintained and judiciously extended, so as to yield results which will justify a further enhancement of the State revenues at next settlement."

The area of *sairaba* lands—excluding *sairaba barishi*—which are dependent on these irrigation works is nearly one-sixth of the total area of cultivation. The proportion is *nil* in Kumber, 5 per cent. or under in Dig, Akheygarh and Weir, from 10 to 20 per cent. in Kama, Bharatpur and Biyana, and 30 per cent. or more in Pahari, Nagar, and Rupbas.

22. The proportion of *chahi* cultivation in each tahsil and its different classes are given in para. 33. It is 10 per cent. or less in Pahari and Nagar, where *sairaba* cultivation is highly developed, and the well water is often of bad quality or (in the old tahsil of Nagar) insufficient in quantity. In Kama and Rupbas the proportion is also low—from 10 to 20 per cent. In the former tahsil the water is often brackish and the spring level far from the surface; in great part of the latter tahsil the supply is poor and the quality indifferent. In all the remaining tahsils the *chahi* area ranges from slightly under one-fourth to a little above one-third of the total cultivation, the proportion being highest in Biyana and Weir, where the wells are generally sweet. For the whole State the *chahi* area comes to 22·5 per cent. or two-ninths of the total, while it pays over 40 per cent. of the revenue demand. The classifications of *chahi* land are :—

Chahi hal—irrigated in the year of attestation.

Chahi sabika—not irrigated within the year, but irrigable and irrigated in recent years.

Temporary chahi—actually irrigated in the year, but from temporary sources, e.g., *dheras* and *dhenklis* constructed owing to drought, etc.

Chahi sairaba, chahi-nahri—lands irrigated from wells, and also by natural flooding or by canals.

The first three classes are found in all tahsils; the last two were added in the southern tahsils, as the well lands, which have also the advantage of natural flooding or canal irrigation are superior in quality. The large proportion of *chahi sabika*—i.e., land attached to and commanded by wells, but not actually irrigated within the year in certain tahsils, especially Pahari, Kama, Kumber, Rupbas and Bharatpur—is due to (1) the insufficiency of the well water owing to the drought of recent years; or (2) the want of sufficient cattle to work the well to its full extent; or (3) the large number of brackish or bitter wells, the water of which, if constantly applied to the same fields, causes the soil to deteriorate, so that the land must often be left fallow or a *barani* crop grown to clear the soil of the saline impurities.

On the other hand, where the well water is sweet—as in Akheygarh, Biyana, and most of Weir—double cropping on *chahi* lands is very common, maize, cotton or *bajra* in the *kharif* being followed by wheat, barley, or *sira* (cummin) in the *rabi*.

23. The following table shows by percentages the proportion of sweet, oily, brackish, and bitter wells in each tahsil:—

Classification of wells by quality of the water.

Wells.	Pahari.	Kama.	Dig.	Kumher.	Akheygarh.	Nagar.	Bharatpur.	Rupbas.	Biyana.	Weir.	Total State.
Sweet	48	58	45	30	58	42	32	72	87	75	60
Oily ... ..	...	...	...	2	7	...	...	2	3	4	2
Brackish	15	30	20	23	14	18	22	11	5	10	15
Bitter	37	12	35	45	21	40	46	15	5	11	23
Total	100	100	100	100	100	100	100	100	100	100	100

In the year of attestation (1897-98 in the northern and central tahsils and 1898-99 in the southern) there were 10,368 masonry wells and 4,752 *kacha* wells at work, while 2,724 masonry wells were left unworked for one reason or the other, the chief being—(1) the crops were grown with the aid of the annual inundations; (2) the wells had run dry owing to the continued drought; (3) where the well water is very bitter, as in Kumher and parts of Bharatpur, half of the wells—and this is especially the case with *kacha* wells—are worked in one year, half in the next, *barani* crops being grown in the alternate years.

Of the masonry wells in actual work, 60 per cent. are sweet and 40 per cent. are oily, brackish, or bitter. The number of masonry wells in the three southern tahsils is equal to that in the remaining seven; and as from three-fourths to seven-eighths of the wells are sweet, it is in these tahsils that well cultivation is most successful. In Kumher, Bharatpur, Dig, Pahari, and Nagar the majority of the wells are brackish, oily, or bitter. No *kharif* crops—such as cotton, maize, or *bajra*—are grown on such wells as a rule, and the *rabi* crops, unless aided by good autumn and winter rains, are apt to be inferior. *Kacha* wells are found in all tahsils, but are most numerous in Kumher, Dig, Kama, Biyana, Bhusawar, and Bharatpur, in which from one-third to one-sixth of the *chahi* area is irrigated from this source. They can also be sunk freely in the flooded lands of Pahari, Nagar, and Bharatpur; and though, owing to the moisture in the subsoil, they do not last for more than a few years under such conditions, they are a most valuable resource in years of drought.

24. The average depth to the spring-level and of the water, as well as the average area irrigated per *lao* or well-wheel, are shown in the following table:—

Spring level and area irrigated per *lao*.

Tahsils.	DEPTH		Area irrigated per <i>lao</i> in bighas.
	To water.	Of water.	
Pahari	20	19	15
Kama	32	19	12
Dig	35	16	10
Kumher	33	17	16
Akheygarh	39	12	18
Nagar	38	16	14
Bharatpur	20	17	16
Rupbas	20	11	13
Biyana	25	20	15
Weir	32	13	17
Total of State	30	16	15

These figures are for the years 1897-98 and 1898-99; but in the drought of 1899-1900 there was a still further contraction in the water-supply (see Assessment Report of Central and Southern Tahsils), which in Akheygarh, Rupbas and Weir threw a considerable number of wells out of working. The favourable rains of the last year and the restoration of the dams in Rupbas and Weir—on the maintenance of which the supply of well water depends in many villages—has caused some improvement, but a few years of good steady rainfall are needed to restore the water-supply to the normal.

The area irrigated per *lao* varies from 1 to 7½ acres, according to water-supply and other conditions, and for the whole State averages 6 acres. The above figures relate to masonry wells. In *kacha* wells, which depend rather on surface and subsoil drainage than on subterranean springs, the water level is generally nearer the surface, but the supply is more scanty and the irrigating power per *lao* or well-wheel is only from one-half to two-thirds of that on a masonry well.

25. For details as to the increase or decrease in wells within the last ten years,—i.e., since the incomplete settlement of 1890—
I may refer to the assessment reports.

The general result is—(1) there has been a slight increase in the number of masonry wells, but owing to the drought the irrigating capacity of the wells has been much reduced, and the saline qualities of the bitter or brackish wells aggravated. Hence there has been a contraction in the area so irrigated, and about 20 per cent. of the masonry wells are temporarily out of work. (2) On the other hand, the drought gave a great stimulus to the sinking of *kacha* wells and to *upary dhers* and *dhentlis* wherever conditions of soil and water allowed of their construction. The number of such wells and the area irrigated from them has risen considerably in certain tahsils. But (3) this resource has not made good the contraction of the irrigation from masonry wells, and in nearly all tahsils the total *chahi* area at this settlement and the area actually irrigated within the year show an appreciable falling off. Given normal rainfall, average years, and an efficient maintenance of the irrigation dams, an improvement in the water-supply and an increase in the area irrigated may be counted upon, as the number of wells is existence in now greater than before.

26. The State by pursuing a liberal and judicious policy in the matter of *takavi* grants for wells, *takavi* can contribute materially towards this result. In the past it has not done sufficient in this respect, as the following figures, showing the advances for wells since 1890-91, prove:—

Tahsils.						Advanced.	Recovered.	Arrears.
Northern tahsils	...	...	...	...	...	17,661	13,150	4,514
Central tahsils	...	...	...	...	...	26,041	22,777	3,264
Southern tahsils	...	...	...	...	...	45,343	39,686	5,657
Total						89,045	75,613	13,432

The average is about Rs. 10,000 per annum. The results have been most successful in the southern tahsils, where no less than 151 new wells have been sunk and 65 repaired with the aid of *takavi*, while 10 are under construction. These figures do not include the advances made in last year's famine. But

throughout the State generally the *takavi* system has not been worked as freely as it should. In this respect Bharatpur might well borrow a leaf from Alwar, where a liberal and judicious *takavi* expenditure within the last thirty years has contributed immensely to the prosperity of the State and the improvement of its revenues, and where this year alone a lakh of rupees is devoted to the purpose. The *takavi* advances in Bharatpur are given free of interest, but hitherto have not been popular with the people, (1) because there is often uncertainty whether the money may not be thrown away owing to the well water turning out bitter, and (2) the system of realisation has been harsh, the first instalment being recovered from the harvest in which the advance is given. The State has now made an important concession in the latter respect, as under the new rules the realisation will not begin for one and a half years after the advance has been made and will be spread over a period of three years or six harvests. These changes will, it is hoped, make the system more popular, and if at the same time a substantial sum of *takavi* is allotted in each year's budget, distributed over tahsils according to the circumstances of each, and the Tahsildars made responsible for utilising these grants to the best advantage, a steady increase in wells and in the *chahi* area may be counted upon. Statistics of the different kinds of wells in use, viz.,—

- (1) *Masonry*—made of stone or brick cemented with mortar ;
- (2) *Patkaura*—made of loose stone locally quarried and roughly dressed, but without mortar or cement ;
- (3) *Kacha-pakka*—which have a masonry lining of from 10 to 20 feet from the mouth ;
- (4) *Kacha*—which have no stone or masonry work, and can only be sunk where the subsoil is firm,—

have been given in the assessment reports. The cost of a masonry well ranges from Rs. 300 to Rs. 1,200, according to the depth and the nature of the subsoil. A *kacha* well costs from Rs. 30 to Rs. 100, and may last from two years to twenty.

27. No less than 58·5 per cent. of the cultivated area is *barani*,—i.e., directly dependent on the rainfall,—while the success of

Rainfall.

the *chahi* and *sairaba* crops also depends largely on the rainfall being sufficient to replenish the wells, fill the tanks, and inundate the *sairaba* lands sufficiently to enable *rabi* crops to be sown. The rainfall statistics, which are available only from 1886, have been discussed in the assessment reports. Rain-gauges are maintained in each tahsil at the local dispensary, and the results are recorded by the Hospital Assistants. For Nagar I could get no data, and took the mean of the tahsils of Gopalgarh in Bharatpur and Govindgarh in Alwar. For Kumbhar the figures were obviously wrong, and I took the mean of Dig and Bharatpur, which are respectively 10 miles due north and south. In Weir there are gauges at Weir and Bhusawar, and there also I took the mean. The following table shows the annual and average fall for the fourteen years, 1886-87 to 1899-1900, and I have also shown the fall for the present year 1900-1901 :—

Tahsil.	Station.	1886-87.	1887-88.	1888-89.	1890-90.	1890-91.	1891-92.	1892-93.	1893-94.	1895-96.	1896-97.	1897-98.	1898-99.	1899-1900.	1900-1901.
Pahar	Pahar	30-81	30-57	33-70	35-05	29-20	32-17	28-60	31-54	20-33	15-20	15-64	13-35	18-16	21-88
Kann	Kann	22-10	27-88	26-75	18-20	35-85	20-02	28-40	36-50	23-00	18-47	17-48	15-50	16-03	34-10
Dig	Dig	23-74	33-81	18-03	25-10	30-60	23-50	31-26	29-00	18-31	31-07	24-30	17-28	14-20	30-59
Kumhar	Kumhar	23-74	33-81	18-03	25-10	30-60	23-50	31-26	29-00	18-31	31-07	24-30	17-28	22-02	22-50
Akhoygarh	Akhoygarh	22-14	33-49	20-14	16-00	21-70	20-01	20-58	23-41	15-51	17-86	24-53	14-22	12-18	21-54
Nagar	Nagar	Not given.													
Bharatpur	Bharatpur	22-45	39-53	18-80	10-05	23-35	37-36	30-24	34-25	22-02	14-00	25-28	24-20	21-08	30-73
Rupbas	Rupbas	24-47	17-37	30-01	25-40	26-00	33-18	24-75	13-09	18-83	10-35	23-04	18-78	23-14	27-62
Biyana	Biyana	10-18	30-46	21-65	20-60	20-70	33-23	22-85	24-75	12-51	11-02	24-88	25-07	24-22	24-08
Wair	Wair	18-54	20-83	27-34	32-46	21-40	38-56	20-00	29-20	18-36	8-31	10-40	28-40	24-44	24-25
		21-77	29-00	22-10	30-60	28-85	37-45	28-34	21-73	12-04	15-10	10-12	18-23	16-50	26-01
		20-22	31-56	28-08	31-40	28-80	33-32	30-57	24-27	12-18	14-31	22-53	27-04	...	...
Total		232-28	337-02	271-32	270-85	285-85	345-26	330-75	304-63	102-12	187-75	282-42	227-63	105-63	273-33
Average of years		22-03	30-80	24-08	25-44	28-80	31-39	30-07	27-51	18-47	17-07	21-13	20-69	19-56	27-33

Thus the average for the whole State for the period of fourteen years is 25.05 inches. Taking the normal rainfall as between 20 and 30 inches, we find that in four years—1887-88, 1891-92, 1892-93, and 1894-95—the rainfall was abnormally heavy, and in three years—1895-96, 1896-97, and 1899-1900—it has been abnormally light. The deficiency has been particularly marked in the last five years, but the present year (1900-1901) shows an improvement which, it is to be hoped, marks the beginning of a favourable cycle.

The variations between the different stations on an average of years are not considerable, though from year to year they are often very marked. Generally speaking, the eastern tahsils,—Kama, Dig, Kumber and Bharatpur,—which are nearer the Jamna-Ganges Valley and more open to the influence of the monsoon current from the Bay of Bengal, have a better rainfall than the western tahsils—Akheygarh and Nagar—adjoining Alwar. But local topographical conditions, *e.g.*, the hills in the northern and southern tahsils, have also considerable influence, and often account for abnormally heavy falls, *e.g.*, over 40 inches in Biyana and Kama in 1892-93. On the whole, the rainfall approximates very closely to that of the adjoining Agra and Mattra districts, the averages of which are—Agra Observatory, 29.12; Fatehpur Sikri, 25.82; Mattra, 26.48 inches; and the State may be said to enjoy a good and fairly regular rainfall, which renders it more secure against famine and scarcity than most parts of Rajputana.

28. Over 90 per cent. of the rainfall is registered within the six months, Uncertainty of the winter rains. —April to September inclusive,—and the average in the six cold-weather months is only about 2 inches. For the *rabi* crop the really beneficial rain is that of December, January, and February (rain in March being injurious), and the average of these months is less than one inch in the southern tahsils, in the central and northern from $1\frac{1}{2}$ to $1\frac{3}{4}$ inches. Even this meagre amount is very uncertain, and in three out of the last five years it has failed completely with most disastrous results to the *sairaba* and *barani* crops. Hence, though the *barani* lands throughout the State are generally well adapted for spring crops—gram, *bejar*, oilseeds, etc.—the uncertainty of the winter, as compared with the monsoon rains, makes the autumn crops more popular and certain. When, however, late autumn rains enable the land to be sown for the *rabi*, and these are followed by good winter rains, an enormous area—some of it having been already cropped in the *kharif*—is put under spring crops. Thus in the present *rabi* there are over 400,000 *bighas* of *sairaba* and *barani* crops, while last year the area was not more than 100,000 *bighas*.

29. The sub-divisions of *chahi* into (1) *chahi hal*, (2) *chahi sabika*, (3) temporary *chahi*, and in the southern tahsils also (4) *chahi nahri* and (5) *chahi sairaba*, and of *sairaba* into (1) *hal*, (2) *sabika* and (3) *barishi* have been already explained. The only remaining classes are (1) *khatil* land in the beds of the Gambhir, Banganga, etc., which after the floods have passed away is covered with a thin layer of ash manure and sown with wheat, barley, melons, or vegetables, and irrigated by hand from *chuhis* or holes dug in the sand, which rapidly fill with water; and (2) *barani*, which is further sub-divided into (a) ordinary *barani*, and (b) *bhur*, the inferior sandy soil found at the foot of the hills, on the high uplands, and along the banks of *nalas*. The area of *bhur* is not however considerable, being 98,409 *bighas*, or less than one-tenth of the total unirrigated area. *Bhur* is most common in the hilly tahsils of Weir and Biyana, and the quality is particularly poor in the latter tahsil, where it grows only the poorest *kharif* crops—*molh*, *masina*, *chawila*, and inferior *bajra*.

In the southern portion of Weir and in the Nahera and Dang tracts of Biyana, the *barani* land is also rather light, the *humus* being of little depth. Throughout the rest of the State it is generally level and uniform in quality, suitable for the growth of all the ordinary *kharif* crops, and if rains are favourable, for *rabi* crops as well. The rate on *barani* land varies from 12 annas to 1 rupee per *bigha*, or Re. 1-14-0 to Rs. 2-8-0 per acre. The rate on *bhur* is

8 annas per *bigha* in Gopalgarh (Nagar), Pahari, Kumber, Akheygarh, Bharatpur, Biyana, Weir; 10 annas in Kama, Dig, Nagar, Oochain; and 13 annas in Rupbas, where the sandy deposits along the banks of the Gambhir produce wonderful crops of *til* and *bajra*.

30. Excepting Jhallawar and isolated parganas of Alwar and Jaipur, the soil of Bharatpur, as a whole, is probably superior to that of any other State in Rajputana. It has also the advantage of a good rainfall, and of having over two-fifths of the area protected by wells or benefited by the annual inundations. The wild cattle nuisance, which for many years was a fatal bar to all agricultural development in Bharatpur and Kumber, as well as parts of Dig, Oochain, and Akheygarh (see para. 7 of Report on Central Tahsils), has now been removed, and the Banganga inundations have been effectually brought under control. The new settlement has defined and secured the rights of the agriculturists in the land, has freed them from many onerous obligations, and given them a reasonable and fairly distributed assessment. The bounteous harvests of the present year have almost obliterated the traces of the recent years of scarcity and hardship, and there is now every reason to hope that an era of agricultural improvement has begun, and that the great latent resources of the State will be rapidly developed.

31. The natural divisions of each tahsil have been fully described in the assessment reports. They might have been made the basis of a division into assessment circles, but this would involve an increase in statistical work, with which neither my establishment nor myself could cope. Had I the time or the local knowledge to form such circles as a preliminary measure, no doubt it would have been helpful in the subsequent proceedings. It is however less important here than elsewhere owing to the small size of tahsils, and the fact that the sub-classifications of *chahi*, *sairaba*, and *barani* now made for the first time, take account of the most salient local distinctions. As I had to assess eight tahsils a year—four in each State—and am convinced that careful local inspection of each estate is more useful for assessment purposes than the most elaborate working out of theoretical rates, I thought it better to treat each tahsil as a single assessment circle, frame soil rates for the tahsil as a whole as a rough guide to assessment, and to depart freely from these rates where local circumstances require it, using my own local knowledge and that of my assistants as a check and correction on the rate estimates.

32. To complete the account of the agriculture in the preceding paragraphs, I annex a table showing for the present year (1900-1901) the relative areas of the different crops for each of the present ten tahsils and for the whole State:—

TAHSIL.	PERCENTAGE OF KHARIF CROPS.										PERCENTAGE OF RABI CROPS.											
	Cotton.	Indra.	Jowar.	Moth Madan.	Gauar chauri.	Til.	Rice.	Cano.	Others.	Total Kharif.	Wheat.	Barley.	Gram.	Bejar (barley and gram).	Chick. (wheat and gram.)	Gojra (wheat and barley).	Oil-seeds.	Tobacco.	Zira.	Others.	Total Rabi.	Total.
Pahari	7	20	20	3	6	6	...	...	1	63	4	5	14	5	3	1	4	...	...	1	37	21
Kama	6	27	15	4	6	2	...	...	1	61	3	6	22	1	5	...	2	...	...	...	33	21
Dig	4	15	26	8	4	4	...	...	1	61	4	8	22	2	...	...	3	...	...	...	33	7
Kumber	2	11	29	12	4	4	...	...	...	62	7	10	17	...	...	...	4	...	...	...	33	3
Akheygarh	3	25	29	17	4	4	...	...	1	74	5	11	6	...	...	1	1	...	1	1	26	4
Nagar	4	20	19	6	6	6	...	...	1	62	5	7	15	3	4	...	3	...	...	...	33	13
Bharatpur	1	12	24	11	3	3	...	...	1	55	16	7	15	4	3	2	3	...	...	1	45	3
Rupbas	4	36	6	7	5	8	...	...	2	63	5	9	5	3	1	2	4	...	1	1	32	11
Biyana	5	33	8	13	4	3	...	...	1	70	6	9	5	4	...	1	1	...	...	4	30	17
Biyana	5	33	8	13	4	3	...	...	1	70	6	9	5	4	...	1	1	...	...	4	30	17
Weir	8	20	13	13	3	3	...	...	1	71	4	11	8	1	1	1	...	...	2	1	23	8
Total of State	6	23	18	9.5	4.5	4.5	...	...	2.5	65	5	8.5	12.5	3	1.5	.5	2.5	.25	1	.75	33	10

Thus no less than 10 per cent. of the cultivated area was double-cropped; and of the total crop area, 65 per cent. consisted of *khariif* and 35 per cent. of *rabi* crops, or, roughly, two-thirds and one-third.

In the *khariif* the only irrigated crop of any importance is cotton. It comes to 5 per cent. of the whole. In the central tahsils it is little grown, as it does not thrive on brackish or bitter wells, but in Weir and Biyana it is a most valuable crop and that on which the Zamindars chiefly rely for the *khariif* revenue. In Pahari, Nagar, and Ruphas it is also an important crop, but there it is largely grown on *barani* and *sairaba* lands.

A small area of rice is grown on the Ruparel flooded land in Nagar and Pahari, and about 300 *bighas* of sugar-cane are raised, chiefly in Ruphas and Biyana. The latter crop appears to have been very extensively grown at one time in the southern tahsils, and efforts, which the State might encourage, are now being made to revive its cultivation. There should be an excellent opportunity for extending its cultivation on the Bareta *band*, and with that object we purposely fixed the water-rate low, Rs. 2-8 per *bigha*.

The chief *khariif* food crops are *jawar* (18 per cent.) and *bajra* (23 per cent.). The two combined cover over two-fifths of the crop area of the year. They are usually grown on *barani* land, though some of the *bajra* is watered from wells and followed by a spring crop, while *jawar* is also grown on *sairaba* lands. *jawar-chari* (4·5 per cent.) is grown entirely as fodder for the cattle.

The area under *til* is also 4·5 per cent. This is a popular and valuable crop, as it always commands a good price. The area is largest in Ruphas, where it is found at its best in the sandy land along the Banganga and Gambhir, but the area is also large in Pahari and Nagar. The miscellaneous *khariif* crops come to 2·5 per cent. of the total, and include maize (grown on the wells in Biyana and Weir), flax, and other minor crops, irrigated and unirrigated.

Of the *rabi* crops, wheat (5 per cent.) and barley (8·5 per cent.), *zira* and tobacco (1·25 per cent.), are generally grown alone on well lands; while gram (12·5 per cent.), wheat and gram (1·5 per cent.), and barley and gram (3 per cent.) are generally grown on *sairaba* or on the best *barani*. Oil-seeds (2·5 per cent.) are generally grown on good *barani* land, or mixed with wheat and barley on well lands. The area under miscellaneous *rabi* crops—carrots and other vegetables, *mehndi* (*henna*), *pan* (betel-nut), and opium—is very small, and is shown by tahsils in the assessment reports. On the whole, the area under the superior crops—sugar-cane, rice, opium, etc.—is very small, the Bharatpur Jats, Meos, and Gujars preferring moderate returns from ordinary crops to the *petite culture* system of husbandry. The agriculture is however on the whole good of its kind, as the State is particularly fortunate—for Rajputana—in that the land is held chiefly by an industrious and enterprising agricultural population.

33. Communications have already been noticed. In the northern and central tahsils they are, on the whole, very good. Akheygarh, Kumher, and Bharatpur have stations at Nadbai, Heylak, and Bharatpur respectively on the Rajputana-Malwa Railway; while Kumher, Kama, and Dig are connected with the railway at Bharatpur and Mattra by an excellent metalled road. Pahari and Nagar, though rather remote, have good communications with Dig, which is an important trade centre.

The three southern tahsils, or at least those portions of them which lie south of the Banganga, are not so fortunate, and during the rains cart-traffic from this side is suspended. There is however a good metalled road from Bharatpur to Biyana *via* Oochain, from which unmetalled or fair-weather roads run to the Bareta and Paharpur quarries on the east, and to Weir and Bhusawar on the west. The Agra-Jaipur road also runs through the Weir tahsil. If the project, which, I believe, has been sanctioned, of bringing the railway from the south through Karaoli and Biyana to connect with the Rajputana-Malwa Railway at Bharatpur, is carried out, much will be done to open up these tahsils and to develop the stone traffic from the Paharpur and other quarries.

34. The fiscal policy of the State till recently had the same paralysing effect on trade that its revenue policy had on agriculture.

Trade.

It was only in 1884 that transit duties were abolished.

Internal customs duties, which were levied on nearly all transactions and were a source of constant annoyance and oppression to the people, were only abolished on 1st June 1896. They brought in a revenue of about Rs. 82,000. Import and export duties on live-stock, agricultural produce of all kinds, and all articles of ordinary consumption are still in force. The rates (which are quoted in para. 97 of my Assessment Report on the Northern Tahsils) were revised and raised considerably in 1896 to compensate for the loss sustained by the abolition of the internal duties. The income is from Rs. 2,40,000 to Rs. 2,75,000 a year; the expenditure about Rs. 30,000. In Alwar—the circumstances of which are very similar to those of Bharatpur—all import and export duties were abolished by His Highness the late Maharaja in 1879. The relief to the people has been immense, and the State has increased in prosperity. I strongly recommend that immediately the Bharatpur finances allow of it, the present oppressive duties be abolished. Where the land-tax and cesses already exceed Rs. 4 per head of total population, there is not that justification for retaining these extra imposts which might be pleaded on behalf of backward (agriculturally) and poor States like Jodhpur, Bikanair, and Odaipur, which derive comparatively little income from their lands.

35. The State realises in addition to the revenue a cess of Rs. 3-2-0 per

Schools, roads, and dispensary cess.

cent. on the *jama*—actual or nominal—of all lands *khalsa* and revenue-free for the payment of Patwaris. This forms

a separate fund, and as will hereafter appear is sufficient not only to meet the pay of the reorganised Patwari staff, but also of the whole Kanungo establishment, and of survey equipment, stationery, etc. Another cess of Rs. 4-11-0 per cent., or 3 pice per rupee—in *masi* villages the rate is usually 2 per cent.—is levied under the name of local rate, to meet the cost of schools, roads, and dispensaries. On the present *jama* the allotment under each head should come to about Rs. 34,000.

In last year's budget the grant for education was only Rs. 26,000, while that for the army was over 6 lakhs. Education is now at a very low ebb, and it is only fair to the people who pay this cess that they should receive the full equivalent of it in the facilities given for at least primary education. As regards medical relief there is no reason to complain. There are dispensaries at the head-quarters of each tahsil, and in fact two in Pahari and Weir; while the new hospital at Bharatpur is perhaps the finest in Rajputana. The unhealthy climate of much of the State renders the need for efficient medical relief all the greater, and the recent revival of the office of Agency Surgeon will no doubt lead to an improvement in the hitherto slack and defective medical and sanitary administration. One of the most useful of recent reforms has been the introduction of British Post Offices. There is at least one such Post Office in each tahsil, and some tahsils have several.

CHAPTER II.

POLITICAL AND REVENUE HISTORY.

36. In this chapter I have endeavoured to bring together, so as to give a

Sources of information.

connected account for the State as a whole, the historical facts already mentioned in the assessment reports. The

sources of information are the Gazetteers of Rajputana and of the Agra and Mattra districts, Captain Walters' brief historical sketch of Bharatpur, Babu Jawala Sahai's "History of Bharatpur" (1898 edition), and Aitchison's Treaties (1892 edition). These have been supplemented by information acquired locally from oral and written sources.

37. The early history of the southern portion of this tract centres round

Early history of Bijana.

Bijana, which nature and art combined to form into one of the most famous strongholds in India even in the days of

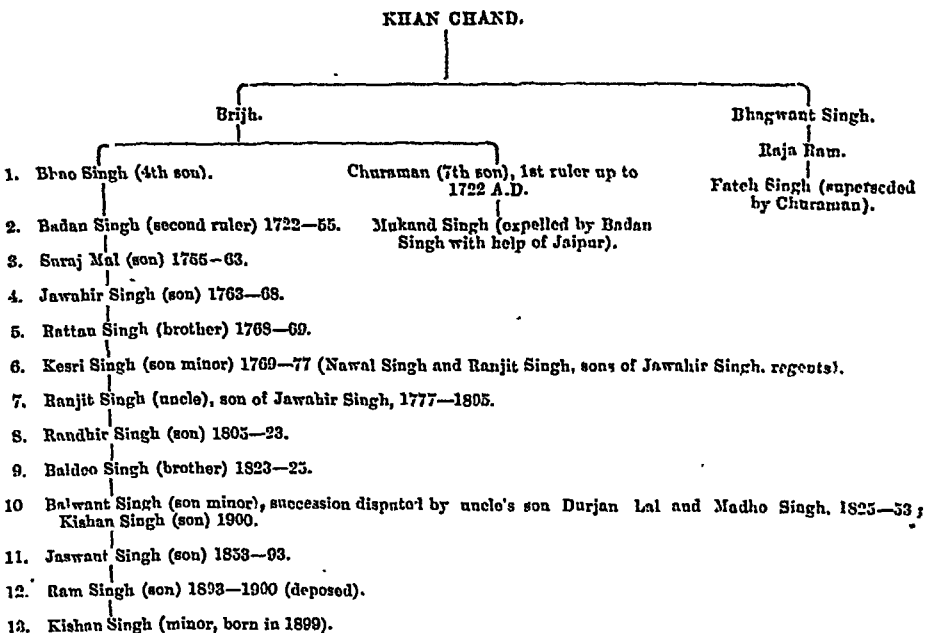
Hindu dominion. During the invasion of Mahmud of Ghazni in the 11th century, a Jadu Rajput, Bijey Pal, ruled in Bijana, and his conduct in endeavouring to

forcibly secure a Mohammedan girl is said to have led to Biyana being stormed and captured in 1031 A.D. by Mahsud Salar, nephew of the Sultan. Bijoy Pal was killed in battle, but the fort is said to have been soon after recovered by the Rajputs. At all events it was again stormed successfully by the famous Abu Bakar Kandhari in A.D. 1047. Abu Bakar was killed fighting, and his tomb is still pointed out close to Biyana. Thenceforward Biyana seems to have been held by whatever dynasty ruled in Delhi. At the end of the fifteenth century the local Governor rebelled against Secunder Lodi, who after capturing Biyana founded a new city at Secundra, a few miles to the south, the ruins of which are still to be seen. This city was situated, like Biyana, at the foot of the hills and covered the entrance to the mighty fort or series of forts which crown the crests, and have even now a circumference of 7 miles. Successive conquerors, Hindu and Musalman, had devoted their energies to the strengthening of this splendid natural stronghold, and it is now a curious medley of Hindu and Mahommedan relics which would well repay antiquarian research.

Babar writing in 1526 describes Biyana as one of the most famous forts in India. The combined Rajput forces, advancing northwards to encounter the Moghul invaders expelled the garrison left by Babar and took possession of the fort, and it was 20 miles to the north-east at Khanwa in Rupsas that Babar put a seal to his conquests and hopelessly shattered the last attempt of the great Rajput confederacy to recover the empire of Hindustan by a complete victory over the Rajput forces under Raja Sanga of Meywar. This victory is known commonly as that of Fatehpur Sikri, which place is however about 10 miles distant from the battle-field. His son Humayun wrested the fort of Biyana from the Lodis in 1535, and from that date to the rise of the Jat power it was held by the Moghuls.

38. The territory now included in the north of the Bharatpur State belonged originally to the domain of the Tanwar Rajputs, Early history of the Mewat. who reigned at old Delhi or Indraprastha, and passed from them with their empire into the possession of the Pathan and Moghul Empires of Delhi. Under Moghul rule the tract was generally attached to the *Subah* or province of Agra, but the Meo tahsils—Gopalgarh, Nagar, Pahari, and Kama—were with the rest of the turbulent Mewat country often placed under the charge of a special officer (Faujdar), and at times were under the administration of the Maharaja of Jaipur, one of the great feudatories of the Empire.

39. The table annexed shows the descent of the ruling family from their ancestor Brijh and the succession up to date :—



40. The rulers of Bharatpur claim to have been originally Jadu Rajputs, the descendants of Krishna. Sue, a Jadu Rajput, the 78th in descent from Krishna, is said to have migrated from Biyana to the Dig jungles and founded the village of Sinsini, named after Sinsina, the *genus loci* or tutelary deity.

Bal Chand, the fourth in descent from him, was a noted freebooter, and in one of his marauding expeditions made prisoners of a Jat of the Dagar clan and his wife from Hindaun (now in Jaipur) and brought them to his house in Sinsini. Having no children by his own wife, he took the Jat woman into his harem and had two sons by her, Bije and Sije. These were regarded as Jats and expelled from the Rajput brotherhood. Having no *gôt* of their own they took the name of Sinsinwar, from their paternal village, and from them are descended the famous Sinsinwar Jats.

These early Jats were Ishmaelites of the jungles, whose sole occupation was plunder. The first to emerge into the light of history was Brijh, the fourth in descent from Bal Chand, who in the latter half of the seventeenth century made himself conspicuous by plundering the baggage of the Imperial forces on their way to and from the Deccan, and finally captured the Moghul fort of Auw, a few miles south of Dig. This was however soon recaptured, and an Imperial force was sent against the Jat stronghold of Sinsini, which was captured at the beginning of the eighteenth century after a bloody resistance. Brijh himself and his fourth son Bhao Singh, ancestor of the ruling family, were killed in the attack, but the Jats proudly assert that five kings' sons were slain with him in the gateway.

Prior to this another branch of the family in the person of Raja Ram, a nephew of Brijh, had established itself in Thun and become master of forty villages. Raja Ram was summoned to Delhi to do homage to the Emperor. According to local tradition he assembled his tribesmen, and agreed that they should share in whatever fortune should bring him. He was well received in Delhi, and in return for his promise to refrain from plundering is said to have been given the *gaddi* of Matira and a grant of 575 villages. On his return he distributed these villages as *inams* among his followers on condition of military service. This was the origin of the present *inam* grants which are so prominent a feature of the Bharatpur tenures. Raja Ram soon returned to his predatory habits, and was soon afterwards killed in a conflict with the Imperial forces. His son Fattah Singh had not the capacity required for a leader of the Jats. They therefore set him aside in favour of the famous Churaman, the seventh son of Brijh.

41. Churaman now became the acknowledged leader of the Jats in Thun and Sinsini. He built forts in both places, and possessed himself of Kumher, Dig, and other places of importance. At this time another Jat named Rustam had established himself at Bharatpur, built a fort, and begun marauding expeditions after the traditional Jat style. Churaman united his forces with those of Khem Karan, the son of Rustam, and the allied bands were now so strong that they were able to attack the Imperial garrisons and cut off the communications of the capital with Ajmir, Gwalior, and Agra. So redoubtable had the Jats now become that the Emperor Farukh Siyar in 1714 endeavoured to conciliate them.

42. To Churaman he gave the title of Bahadur Khan with a *jagir* of the five parganas of Nagar, Katumbar (now in Alwar), Nadbai (in Akheygarh), Heylak (in Bhartapur), and Auw (in Dig; while Khem Karan received the 5 parganas of Rupbas, Bharatpur, Ikran (in Bharatpur), Mala, and Baroli (Agra). Upon this they ceased plundering for a time, but hereditary inclinations were too strong and opportunities too tempting for the Jats to adopt a life of peace. The Russians have a proverb, "However you may pamper a wolf, his eye is always on the forest".

They soon resumed their successful career of plunder under Churaman, and in 1718 the Raja of Jaipur was despatched with a strong force to overcome him. Thun and Sinsini were invested, but the Jats showed the same valour in defending their mud walls which won for them so much celebrity a century

later, and after several unsuccessful assaults the Raja raised the siege and returned to Jaipur.

According to Tod and Elphinstone (page 689) the Jats had been reduced to extremities, and Thun was about to capitulate when the Sayad Wazirs of the Empire, who were at the head of a faction opposed to the Jaipur Raja, made peace direct with the Jat Envoy in Delhi, and the Raja thereupon retired in disgust. This is corroborated by the fact that a year later—in 1720—Churaman supported the Wazirs against the Emperor Muhammad Shah, for which he received a reward of 200,000 gold *mohurs*, and in return he murdered the Governor of Agra, who was hostile to the Wazirs.

43. To avenge this outrage Raja Jai Singh of Jaipur was appointed Governor of Agra and prepared to attack Churaman in overwhelming force. Meantime Churaman had quarrelled with his son Mohkam Singh. On returning from the chase one day he found the fort of Thun shut against him, and in despair the "Cincinnatus of the Jats" took poison by swallowing a diamond (1722 A.D.)

His son Mohkam Singh was a profligate. His first step was to imprison Badan Singh, the son of Bhao Singh, whom he feared as a rival. The Jats insisted on the release of Badan Singh, who fled to the Imperial camp, and invited Jai Singh (with the consent of the great body of the Jats, it is said,) to attack Thun and expel Mohkam Singh. Aided by a strong faction among the Jats, Jai Singh captured Thun after a six months' siege, and Mohkam Singh fled for his life. He had previously laid a mine of gunpowder to blow up the fort and his assailants when they should enter it, but Badan Singh forewarned the Jaipur Raja of the stratagem and thus saved him from annihilation.

44. For his services he was proclaimed Raja of Dig, on condition of paying tribute to Delhi, in 1722, which year therefore marks the recognition of Bharatpur as a separate State. He made Dig his capital, built the older palace there, erected the forts and palaces of Kumber and Weir, and extended his territory to the present southern boundary of the State. He had twenty-six sons, of whom the eldest, Suraj Mal, became *de facto* ruler in his father's lifetime. Sixteen sons left issue, and these are the founders of the *solah kotris* or sixteen houses that still hold *jagirs* and *inams* dating back to the reign of Badan Singh. They are known as Thakurs, while other Jats of the Sinsinwar got are styled Faujdars.

45. Badan Singh after his accession appears to have left affairs of State to his capable and successful son Suraj Mal, who raised the Jat power to its zenith. In 1733 he captured the fort of Bharatpur from Khem Karan, the rival Jat Chief, and laid the foundation of the present capital by building the present fort and moat.

His subsequent career is part of the history of Hindustan. In 1753 he sacked Delhi; in 1754 he successfully repelled the combined attack of the Imperial forces, aided by Holkar and Jaipur, from Dig and Bharatpur; and again signally defeated Holkar at Kumber, where Holkar's son was slain. The dispute as to the succession to the Jaipur throne was decided in favour of Isri Singh by the influence of Suraj Mal's sword.

From the death of Badan Singh in 1755, Suraj Mal ruled as Maharaja in his own right till his death in 1763, and at this period was probably at the head of the most formidable force in India. His crowning and most brilliant achievement was the capture of Agra in 1761, (which the Jats held till 1774,) together with the sovereignty of the Agra and Mattra districts, most of the present Alwar State, and parts of Gurgaon and Rohtak. Suraj Mal met his death in 1763 at the hands of a squadron of the Imperial forces while making a foolhardy attempt to hunt in the Imperial domains.

46. His son and successor, Jawahir Singh, possessed the valour without the capacity of his father. In 1764, with the help of the Sikhs from the Punjab, he plundered Delhi and added Jhajjar, Bahadurgarh, and Rewari, with a considerable part of the present Gurgaon and Rohtak Districts, to the Jat possessions. During his short reign he lived chiefly in the Agra palace, where it was his whim to sit on the black marble

throne of Jahangir, and here he was murdered at the instigation of the Raja of Jaipur in 1768.

That the power of the Jats, though their dominions were now at their widest, had passed its zenith under Jawahir Singh, appears from the evidence of Dow, a contemporary historian—see page 620, Agra Gazetteer—who writes :—

“The city of Agra and a very considerable tract of the country round it, extending along the Jamna from 40 *kosas* below the city to within five of Dehli, and stretching back to Gwalior, are in the hands of a Hindu nation called the Jats. Jawahir Singh is a very weak prince. The revenue does not exceed two crores; his dominions, like the rest of India, being harassed by the Mahrattas.”

47. From the death of Jawahir Singh the power of the Jats began to decay and their dominions to contract. The process was hastened by family dissensions, the increasing influence of the Mahrattas on the politics of Hindustan, and the rise of a powerful rival in the Chief of the newborn Rajput State of Alwar, to whom the Alwar fort was surrendered by the Bharatpur forces in 1775, and who by the end of the century succeeded in expelling the Jats from the northern parganas of Alwar.

In 1771 the Mahrattas expelled the Jats from all their conquests east of the Jamna. In 1774 Najaf Khan recaptured Agra for the Emperor. The contest for the Regency between Nawal Singh and Ranjit Singh during the minority of Kesri Singh (1769—77) gave the Imperial Wazir, who espoused the cause of the latter, an opportunity for re-establishing Moghul supremacy. By the defeat of Nawal Singh at Barsana and the capture of Dig in 1775 he broke the power of the Jats and re-annexed all their territory, except the Bharatpur pargana which was left to Kesri Singh, to the Moghul dominions. The fortunes of the Jats, which were now at their lowest ebb, were partially restored by the Rani Kishori, the widow of the great Suraj Mal. Her personal appeal to Najaf Khan obtained the restoration to Ranjit Singh in 1777 of 10 out of the 14 (now reduced to 10) parganas which now form the State. To this period is attributed the origin of the *chauth* form of tenure in several Jat estates. For some years Ranjit Singh held these 11 parganas under the protection of the Minister Najaf Khan. The latter died in 1782, and his successor, Mirza Shaffi, confiscated the Jat possessions. Mirza Shaffi was murdered at Dig in 1783 with the connivance of Ranjit Singh, who took advantage of the dissensions between the Moghuls to recover his lost territory. This brought him into collision with Madho Rao Sindhia. The latter at this time, though posing as the Deputy of his nominal master the Peshwa, who in turn claimed to be merely the chief noble of the Empire, was rapidly becoming the master of Hindustan.

48. On behalf of the Emperor, Sindhia in 1784 again forfeited Ranjit Singh's possessions, but on the petition of Rani Kishori 11 parganas, including Dig, yielding a revenue of 10 lakhs per annum, were again restored in 1785. Thenceforward Ranjit Singh attached himself faithfully to the cause of Sindhia and loyally co-operated with Sindhia's French Generals, DeBoigne and Perron. Perron appears to have succeeded to the command of Sindhia's Hindustan army in 1795, and as Sindhia's representative at Dehli and Agra exercised an unlimited influence over the Emperor. He rewarded Ranjit Singh's services at this time by the grant of 3 parganas valued at 4 lakhs per annum, thus making up the Bharatpur State to 14 parganas. This constitutes its present extent, though the number of parganas has now been reduced to 10. The present boundaries were therefore stereotyped at the close of the last century.

49. The early years of the present century were marked by the final struggles of the Mahrattas and the British for the supremacy of India. On 29th August 1803, Sindhia's forces under Perron were defeated at Aligarh by Lord Lake. On the 14th September Lake occupied Dehli, and the French generals Perron and Bourgnien surrendered. Lake then returned to the siege of Agra, which was begun on 7th October. Ranjit Singh on 29th September 1803 concluded an offensive and defensive

Political Agent, but the latter remained at his post at Bharatpur till 9th July, when, as the local Chiefs could no longer be responsible for his safety, he repaired to Agra. On 18th October 1857 Captain Nixon returned to Bharatpur as Political Agent. The Agent to the Governor-General in his mutiny report writes that though

“the Darbar had scarcely a soldier on whom reliance could be placed, and could with difficulty enforce obedience at home, no outrages have been committed in the districts, nor has the name of any Jat *Sardar* been implicated in any way in the insurrection against British rule.”

The Gujars and some of the Meo villages—as in Alwar and neighbouring British provinces—gave trouble by their rebellious and predatory habits. A special British force had to be placed on the Khairagarh border to guard against the incursions of the Bharatpur Gujars, while the Meos of the northern parganas joined their brethren in Gurgaon in plundering Firozpur, Nuh, and other towns.

- (3) The cession of the land required for the Rajputana-Malwa Railway free of cost in 1865 and the opening of the line in 1874.
- (4) The installation of Maharaja Jaswant Singh in 1869.
- (5) The extradition treaty of 1868 for the mutual surrender of prisoners charged with certain offences and the agreement modifying it in 1887.
- (6) The salt agreement of 1879 prohibiting the manufacture of salt in Bharatpur on payment of Rs. 2,20,000 as compensation to persons engaged in the trade, and of an annual grant of Rs. 1,50,000, together with one thousand *mans* of salt, to the State.
- (7) The abolition of all transit duties, except those on opium, liquor, and intoxicating drugs, in 1884.
- (8) The transfer from Alwar to Bharatpur in 1885 of five estates, of which four are now in Gopalgarh and one in Akheygarh, *viz.*, Pipal Khera, Maliki, Nakatpur, Bakhshuka, Thalchana, in exchange for the following five villages now in tahsil Katumbar, Alwar State—Khera, Lalke, Sita Ram ka Nangla, Mian Khera, Garo.
- (9) The death of Maharaja Jaswant Singh in 1893 and the succession of his son, Maharaja Ram Singh, whose powers were withdrawn in 1895.
- (10) The abolition of internal customs in 1896.
- (11) The birth of a son to Maharaja Ram Singh in 1899.
- (12) The deposition of Maharaja Ram Singh and the succession of his infant son, Maharaja Kishan Singh, in August 1900.

Having briefly referred to the political history of the State, the fiscal history may now be considered.

53. The origin of the *inam* and *chauth* tenures has been already referred to. The *inams* were feudal grants of estates made by the earlier rulers—the alleged grant of the Mattra *gaddi* with 575 villages by the Emperor of Delhi to Raja Ram is probably a fiction invented to give a more legal origin to the grants—to their brothers in arms as a reward for past or a guarantee for future military services. These services were defined in each case as so many guns (*banduks*), *i.e.*, so many matchlock-men, and the area of land represented by one gun varies from 25 to 150 *bighas*. As the State expanded and more fighting-men were required, so did these grants. The original grantees in their turn distributed among their kinsmen the grant and the obligation, and this accounts for the fact that shares in the estate are measured by the number of guns or the fraction of a gun that the *inam* or *chauth* holder is bound to supply. The *chauth* villages now paying one-fourth of the rental were originally *inam* or revenue-free. The tradition as to their origin is that when Najaf Khan seized Dig (which he held for the Moghuls for several years) and Kumer in 1774, the *Inamis* who flocked round the standard

of the Maharaja Ranjit Singh at Bharatpur, rather than serve the Moghuls, were on the rendition of the 11 parganas by Najaf Khan restored to their full former privileges. On the other hand, those Inamis who accepted Moghul dominion were made by Najaf Khan to pay one-fourth as the condition of holding their lands. When the parganas were restored they petitioned to be allowed to hold in full *inam* as before, but the Rani Kishori maintained the contribution of one-fourth, as well as the full obligation for military service. This liability for the 26 *chauth* villages originally amounted to 331 guns, of which, owing to death, desertion or absence, 37½ have been resumed and 293½ are still upheld. The commutation or penalty for absence appears to have been introduced in the reign of Jawahir Singh. When he made his famous raid on Delhi, those Inamis who refused or were unable to join him were made to pay a penalty of Rs. 5 per month per gun, this being the ordinary pay of a sepoy at the time, to enable substitutes to be entertained. This is said to have been the recognised rate of commutation till the time of the late Maharaja, who at the very beginning of his reign endeavoured to make *inam* and *chauth* holders liable for *patwar* and other cesses, and to overcome their opposition reduced the penalty for absence to one rupee per gun per month.

The effect of resumptions and efflux of time has been gradually to convert the nominal tenure according to shares in guns into an actual tenure by possession. Though these *inam* and *chauth* villages are nominally joint and undivided, separate possession has long been recognised, and frequently, in fact generally, does not agree with shares. In *inam* and *chauth* estates the owner of one gun will be found in possession of 30 *bighas*, of another gun in possession of 50; and though the liability of both is nominally the same, the *chauth jama* assessed is paid and resumptions made according to possession. Shares are however generally recognised in the *shamilat*. Most estates similarly pay the penalty for absence (*ghair hazri*) according to possession with the land revenue; only a few still pay the revenue and penalty according to shares.

54. The conquest of the southern tahsils by the Jats between 1720 and 1750 A.D. has been related already. The pargana of Wair in Bhusawar was granted as a separate *jagir* by Badan Singh to his second son, Partab Singh, who built the present fort and palace, beautified the place with tanks and gardens, and enjoyed the title of Raja. Maharaja Jawahir Singh suspected him of intriguing with the Moghuls and aiming at setting up a separate State. He therefore captured Weir and forfeited the *jagir*, leaving Partab Singh only 12 villages for his maintenance. These his descendants held for some generations with the title of Raja. Maharaja Balwant Singh reduced the grant to the two villages of Barha and Salempur; and on the death of Daryao Singh the late Maharaja resumed even these and gave a cash allowance instead to the present head of the family, Raja Samundar Singh, who is pursuing his studies in the Mayo College.

In the same way Thakur At Ram, younger brother of Churaman, and the ancestor through his adopted son, Sardul Singh, of the Pathana Thakurs, received a grant of Haleyna and about 200 villages in the vicinity. He built a fort at Haleyna, which still exists. When Jawahir Singh attacked Weir, the Haleyna Chief, Sawai Ram, who was in charge of the operations, was suspected of intriguing with Raja Partab Singh. His large *jagir* was at once confiscated, only a small portion being left for his maintenance. Even this has been gradually resumed, and the descendants of At Ram now hold only a small area in Haleyna as sub-proprietors.

55. These two cases are typical of the manner in which the Bharatpur Chiefs aggrandised themselves by absorbing the possessions of their feudatory Jagirdars. While the State was still growing under Badan Singh and Suraj Mal, and these Chiefs had need of the strong arm of their Jat kinsman, the services of the latter were rewarded by liberal grants of *jagirs* and *mafis* from the conquered territory. Thus grants on a large scale were given to the sixteen sons of Badan Singh, known as the

prosperous portion of the State. It has however suffered most in the recent famine, though the Meos have shown extraordinary recuperative power. Whatever their habits formerly, they now run the Jats close for industry, but their faults are love of litigation and occasional bursts of extravagance. The only other Musalman tribe worth mentioning are the Gaddis, who possess 16 villages in the southern tahsils. They are said to be converted *Khatris* from the Punjab, and though enterprising in other ways, are poor as agriculturists.

The leading characteristics of the different tribes have been described in the assessment reports. Agriculturally I class them as follows:—

Good cultivators—Abirs, Malis and Kachis, other Jats, Meos, Dhakurs, Minas.

Fair—Sinsinwar Jats, Gujars (part), Brahmins.

Bad—Lodhas, some Gujars, Rajputs, other Musalmans.

Thus over 40 per cent. of the estates are in the hands of really good, 50 per cent. of good or fair, and only 10 per cent. are held by poor agriculturists. The Gujars in the Bharatpur tahsil have hitherto been amongst the worst cultivators in the State, but this was largely due to their unfavourable environment—water-logging from the Banganga and wild cattle; and now that these checks upon industry have been removed, they are showing more disposition to make use of their opportunities. The State, on the whole, will compare favourably with any in Rajputana in the character of its agricultural population.

✓ Revenue system under the Moghuls.

58. I now proceed to sketch, as briefly as possible, the revenue history.

In the “Ain-i-Akbari” the tract is shown as belonging to the Agra *sirkar* or district of the Agra *subah* or Province. In the following table I quote the *mahals* or sub-divisions mentioned in the “Ain-i-Akbari”, which can be identified as now included in the Bharatpur State, with the land revenue then levied from them:—

Pargana or mahal.	Land revenue, in rupees.	Tahsils in which now included.
	Rs.	
Biyana	1,77,753	Biyana.
Bhusawar	1,37,636	Bhusawar.
Khanwa	73,056	Part of Rupbas.
Kumher	18,650	Part of Kumher.
Heylak	69,717	Part of Kumher.
Pahari	30,725	Pahari.
Kama	12,613	Kama.
Mucira	15,453	Kama.
Ol (part)	1,37,738	Kumher and Bharatpur.

Unfortunately owing to the difficulty of identifying the old with the present names, the comparison cannot be made complete. So much however is evident that the three old parganas of Biyana, Bhusawar, and Khanwa, which now go to make up part of the four southern tahsils, then paid a land revenue of Rs. 3,88,445, or more than half of what the whole tract pays at present. I have shown in Chapter II of my Report on Alwar that in Akbar's time the prices of agricultural produce were only from one-fourth to one-sixth of what they are now, so that even assuming that the, assessment then was only half of

what it is at present, the proportion of the produce then taken, *i.e.*, the pitch of the assessment, was very much higher than it now is. This is also evident from the fact that Akbar's standard of assessment was one-third of the estimated produce—and his estimates were pitched very high as shown in my Alwar report—converted into cash at the current prices of the year, or the average prices of the previous ten years.

59. Prior to the Summary Settlement the State in theory took one-third of the produce—a relic of Akbar's land-revenue system—Old revenue system under Bharatpur rule. which was levied either by actual division of the crop (*batai*), or more frequently taken by appraisal of the yield of the standing crop (*kankut*), which was converted into a cash demand at the current rates. A further development of this led to the *theka* or contract system, by which the Zamindars or a middleman (*thekadar*) contracted to pay a fixed sum for a year or a term of years. In practice however the State took all it could exact from the people, and much of the residue was swallowed up by rapacious and corrupt officials.

For the revenue history of the State prior to the establishment of the Revenue administration, agency, I cannot do better than quote the graphic account given in paragraphs 3 to 6 of Sir H. Lawrence's (then Agent to the Governor-General in Rajputana) report, dated 4th March 1857, to the Secretary to Government of India:—

"3. Under the late Raja Balwant Singh, the prince put up by Government after the siege of the capital in 1825-26, the territory yielded about 20 lakhs of rupees. The Raja was mild and weak, but had received little or no education, and was governed by favourites, the principal being two barbers. Five years before his death he introduced a field measurement in the territory, but used it solely and entirely as an engine of extortion. The assessment of many villages was doubled, the burdens of all more or less increased. Extra cesses, fees, and perquisites to officials had always been a dead weight on the territory. They had however sometimes enabled villagers to escape direct over-taxation. The survey removed this wretched means of escape. The consequence was that many estates were abandoned, and very many greatly impoverished. The practice of the country had been annual assessment, on a rough inspection by pargana officers, of crops as they were about to be reaped. This duty was often left to a common sepoy on two or three rupees a month. The Maharaja intended the settlement to be for ten years, but left no distinct orders on the point. Instead of a blessing, it proved to be a curse.

"4. The pargana officers had almost unrestricted power in all departments within their limits, restricted only by the fear of spies, wretchedly paid newswriters, and a haphazard visit by the Maharaja. Honest or dishonest, they were subjected to fines. Not one in ten escaped. Some paid heavy *nazarana* on appointment, several were under stoppages towards the liquidation of fines to amounts exceeding their full annual pay and allowance.

"5. The army under the Maharaja amounted to about 8,000 men. All were and are extremely well-behaved. The Maharaja had striven to break the spirit of the people, especially of his own tribe, the Jats, inhabiting the central parganas of Dig and Bharatpur. With this view he had, where able, commuted their *jagirs* and *inams* to money payments, and restricted their employment, balancing them with foreigners and Gujars."

60. The Bharatpur Agency, with Major Morrison as Political Agent, was established in 1853 on the death of Maharaja Balwant Singh, whose son, Maharao Raja Jaswant Singh, was then only two year's old, and the administration was conducted by the Political Agent and a Regency Council till 10th June 1869, when it was made over to the young Maharaja with certain restrictions, which were removed in 1871. From that year he reigned with full powers till his death in 1893.

The former assessments and Summary Settlements were all carried out between the year 1853 and 1893. They were as follows:—

The Summary Settlement for three years, 1855—57, was made in August 1855 by Sir H. Lawrence himself for the three tahsils of Gopalgari, Kama, and Pahari, and by Captain Nixon, one of his assistants, for the rest of the State. The demand was based on the average collections of the previous ten years, and amounted to Rs. 14,16,000.

(a) Summary Settlement, 1855-57.

CHAPTER III.

SURVEY AND RECORDS.

64. As regards the preparation of maps and records in the new settlement—^{Employment of local agency.} which is the first Regular Settlement of the Bharatpur State—the principle laid down by the Government of India was that this work should be carried out by the local Patwari and Kanungo agency. In the Government of India letter No. 1949-I. A., dated 17th June 1896, para. 3, issued after receiving Mr. Colvin's memorandum of March 1896, the following directions were given :—

“In the Alwar State a new survey has apparently been undertaken by a staff of Amins. It should be stated, firstly, whether this survey has been founded upon a professional traverse, so that the map can be used as the basis of topographical maps; and, secondly, whether the services of village officers are being utilised for the work.

“The Government of India attach considerable importance to the employment of the latter agency for both survey and settlement purposes, for by this means not only are the original operations reduced in cost and conducted with a minimum of harassment to the people, but the trained agency, which is necessary for the maintenance of a permanent record, is assured, to the avoidance of periodical surveys and revisions and to the great benefit of the State in other respects. The same remarks apply with still greater force to the Bharatpur State, where it is understood that survey operations have not yet begun. It will, therefore be to the advantage of both Darbars that, on his return, Mr. Colvin should first proceed to Gwalior to make himself acquainted with the details of the above system as successfully introduced there by Colonel Pitcher.”

On the receipt of a further report from the Political Agent, the same principle was emphasised in para. 2 of their letter No. 43-I. A., dated 5th January 1897 :—

2. “In the matter of survey nothing further remains to be done in the Alwar State except to extend the measure to jagir and *istimrari* villages and to check the results of the recent operations. In the Bharatpur State some time has elapsed since the last survey and no *khairahs* now exist; probably, therefore, a re-survey will be necessary. Should this be the case, Amins should not be employed, but village officials should be utilized for the reasons given in my letter No. 1949-I. A., dated the 17th June 1896. Their initial training which Colonel Loch has already begun, should not occupy more than a few months, and the saving in cost will more than compensate for the short protraction of the operations; moreover, by this means future settlements will be both cheapened and simplified. On the other hand, if the Darbar lose the present opportunity, they will indefinitely postpone the introduction of the system of village agency, which in Gwalior, as in British India, has resulted in increased efficiency combined with great saving of expense.”

These directions have been acted on throughout. The Patwari agency, which in Bharatpur is fairly well paid and strong in numbers, though at the beginning weak in all knowledge of revenue work beyond that connected with realising the revenue, has been utilised throughout for amending the maps and preparing the new records.

65. The Kanungo establishment was however ^{Supervising establishment imported.} very weak,—only one or two men per tahsil,—badly paid, and inefficient, and had to be supplemented by a strong body of settlement trained Munsarims borrowed generally from the Patwari or Settlement establishment of Punjab districts. From six to ten of such men—paid from Rs. 20 to Rs. 30 per month—were employed in each tahsil to train and supervise the Patwaris and local Kanungos. The work in each tahsil was under the immediate supervision of a Sadar Munsarim on Rs. 40 to Rs. 60 per mensem—corresponding to a Deputy Superintendent in Punjab Settlements. These were in, the beginning borrowed from among the best Kanungos in Punjab districts and later on were selected from the best of the Munsarims.

Nearly all of the Munsarims and Sadar Munsarims who had not already secured certificates of efficiency as Kanungos were encouraged to obtain them, and by the courtesy of the Director of Land Records, Punjab, were allowed to present themselves for examination. The result has been most satisfactory. Of 43 men who appeared, no less than 20 have passed the examination—several with credit. Thus those who were Patwaris in the Punjab have qualified themselves for promotion to the post of Kanungo, while those who have hitherto held no substantive post have, by the possession of certificates of efficiency, bettered their chances of future employment. All round, this imported agency has done extremely well for the State and for itself. In the reorganisation of the State Revenue Department two Sadar Munsarims, who were formerly Kanungos in the Punjab, have been appointed Naib-Tahsildars, and a third has been appointed Naib-Sarishtadar in the Council office; 9 men have been appointed as Kanungos in the tahsils, others have received posts in the clerical establishment, while most of the remainder are likely to receive employment in the Patiala State Settlement.

66. The superior agency consisted of—(1) Mr. A. H. Pyster, an officer borrowed by Mr. Colvin from the Bengal Survey in January 1897. He started the work in the northern tahsils, prepared the preliminary record in Akhegarh and Bharatpur, and was in direct charge of the settlement operations in Rupbas, Ochain, and Biyana from start to finish. On the close of the settlement he takes up a similar appointment in the Indore State Settlement. (2) Sayad Mahmud Hossain had been employed in the State as sole Deputy Collector from 1894. As he had been trained in Punjab settlements, and had a good knowledge of the revenue system of the State, I decided, with the sanction of the Darbar, to utilise him in the settlement, giving him a special settlement allowance, while at the same time he carried on the duties of Revenue Deputy Collector. He has held charge of the work in the four tahsils—now reduced to three—of Pahari, Gopalgarh, Nagar, and Bharatpur. The experience he has thereby gained will be useful to him in carrying on the duties of Deputy Collector hereafter. (3) Munshi Hira Singh, who was a Settlement Tahsildar and is now a qualified candidate for the post of Extra Assistant Commissioner in the Punjab, was lent to me for employment in the settlement in September 1897. He has been in charge of five tahsils,—Dig, Kama, Kumher, Akhegarh, and Blusawar,—embracing nearly half of the State, and the most complicated and delicate portion of the work. I have no hesitation in saying that without his thorough knowledge of settlement work, sound judgment, readiness of resource, capacity of adapting himself to local conditions and of getting the best work out of inferior instruments, the settlement of the State would have been a longer, costlier, and more difficult operation than it has proved. The State is to be congratulated on the fact that it has secured his services as joint Deputy Collector from 1st April 1900 for a term of five years, which should be extended by a similar term if his work proves as thorough and satisfactory in the future as in the past.

67. A revenue survey of the whole State was made by the Survey Department in 1856—58, and the village maps then prepared, on the scale of 4 inches to the mile, though out of date in some respects, are still very useful for topographical purposes.

Survey and records of rights:
(1) General maps of the State and tahsils.

These maps were reduced by the Survey Department to the scale of one mile to the inch, and maps of the different tahsils showing village boundaries and the ordinary topographical details were issued between 1857 and 1868. These maps are now in many respects obsolete owing to alterations in tahsil boundaries,—the number having been reduced from 14 to 10,—changes in villages, streams, exchange of villages with Alwar State, etc. A new map of the State on the scale of 1 mile to the inch is absolutely necessary, and the following arrangements have now been made to secure it.

The old professional survey sheets on the scale of one mile to the inch (which show village boundaries and all the main topographical details as they

existed when the maps were made) have been carefully pieced together, so as to give a complete map of the State on one sheet—

This map has been brought up to date by showing—

- (a) the boundaries of the tahsils as now fixed;
- (b) all changes of village boundaries owing to the splitting up of one estate into two or more, or the clubbing of two or more estates into one;
- (c) the correct names of the estates, those on the printed survey sheets being frequently grotesquely erroneous;
- (d) further topographical details which will make the map more valuable for reference, *viz.*, new roads, canals, and large irrigation dams restored or constructed by the State;
- (e) corrections of the old topographical details where erroneous, *e.g.*, as regards the alignment of the Rajputana-Malwa Railway;
- (f) changes in the course of the Banganga and other streams since the professional survey maps were prepared.

This revised and corrected map has been sent to the Executive Engineer for further check and correction, and when it has been passed by him it should be sent, with a complete index giving the correct spellings of the names of villages, etc., to the Surveyor General's office at Calcutta, who should be asked to have 100 copies struck off, if possible, for distribution and record. This will dispose of the case as regards the map of the State. Twenty-five copies of the corrected map of each tahsil on this—1 mile per inch—scale have been lithographed and distributed to all the offices in the State.

Field maps on the scale of 20 to 24 inches per mile were prepared by (2) Field maps of each Patwaris and Amins in 1856—58 after the village boundaries had been defined by the survey officials. These were not however kept up to date, and as no new maps were prepared or old maps revised up to the settlement of 1890, they had become obsolete. As already described in Chapter II, a plane-table survey of the State was made in 1883—90 as a preparation for the new assessment, under the supervision of Sheikh Asghar Ali, Deputy Collector, and Dr. Rahim Bakhsh, through the agency of imported Amins and Munsarims. This survey cost about Rs. 65,000. It was fairly accurate, but the assessment papers and records of ownership, cultivation, etc. were quite incomplete and unreliable.

In March 1896 Mr. Colvin made a brief inspection of the maps and records prepared in the 1890 settlement, and came to the conclusion that the record was unreliable and must be prepared anew, but that the maps then prepared might be utilised if they stood the test of checking by a trained Surveyor.

In the hot weather and rains of 1896 a capable Surveyor was deputed for this purpose from the Survey Office, Calcutta, who made an independent check of 24 maps, two in each tahsil. The method adopted was to take two fixed points in each estate, survey from the line between them by offsets on the various field boundaries, and compare the results with the maps prepared in 1889-90 by the Amins, which meantime were kept under lock and key. The comparison was carried out in the Survey Office, Calcutta, and the Deputy Surveyor-General, in returning the settlement maps with the corresponding traces of the re-survey of the boundaries and of the check line in each, wrote (see his letter No. 1119, dated 3rd December 1896):—

“You will perceive that the old maps are fairly correct as to the peripheries, and that, when a field is identical in shape in the two maps, its agreement is good, but there seems to be a number of changes. Your maps, when brought up to date, will serve as indexes, showing the relative position of all details, to the *thasras* which contain the measurements for area purposes, but the maps not being accurate survey cannot take the place of professional maps.”

This report showed that for assessment purposes it was sufficient to bring the maps of 1889-90 up to date, and this is the line that has been followed—new surveys having been made in a few cases where the existing maps were found to be very incorrect, or where considerable changes had taken place owing to partition, breaking up of waste, etc.

68. The total number of estates re-surveyed was only 21. In all other estates the maps of 1890 were brought up to date, viz., those of the northern and central tahsils in 1897-98 and those of the southern tahsils in 1898-99.

Correction of the field maps. The method adopted was that copies of the original maps were made on tracing cloth. The tenure of the village having been determined by the Deputy Collectors, the shares—where owners held by shares—fixed, and the *khatauni* holdings written out, the Patwaris made a field to field inspection of the village, wrote up the *khaskra*, compared the field boundaries, linear dimensions, and areas as shown in the old *khaskra* with those ascertained on the spot, and made necessary corrections in the tracing where (1) the boundaries had changed, or (2) the area was erroneous, so that the tracing should accord with existing conditions. All amendments were shown in red ink, and after they had been checked by the expert staff of Munsarims and Sadar Munsarims the original maps of 1890 were amended accordingly. At the beginning of the work the areas were extracted in the office by the *bigha* comb; but after I assumed charge, I insisted that the areas should be worked out in the field by the ordinary rules of mensuration and at once entered in the Zamindars' or cultivators' *parcha*. This was a useful check on the accuracy of the work.

Records prepared in the village.

69. The following papers were prepared locally :—

- (A) *Shajra nasib* or genealogical tree. This shows descent of the owners from a common ancestor where possible, existing shares, etc. It was prepared by the Munsarims, and, as far as possible, efforts were made to connect it with the common ancestor. Where this was not practicable, only as many generations were shown as were necessary to determine shares, etc.
- (B) *Khataunis* or lists giving details of the fields in each proprietary and tenancy holding. These were prepared concurrently with the *khaskra* and the amendment of the field map.
- (C) Field map (*shajra*) and field registers (*khaskra*) and statement of wells.

All these documents were prepared in the first instance by the Patwari, and checked on the ground by Munsarims, Sadar Munsarims, and Circle officers.

70. Since the summary settlement a cess (known as *dam*) of Rs. 3-2-0 per cent. on the *khalsa* land and of two pice per *bigha* or per rupee on the valuation of revenue-free land has been levied on account of the Patwari's pay. This is a relic of Akbar's system, in which one *dam* per rupee was levied for a similar object. The funds thereby provided are ample for the purpose, but they have never been properly applied.

Prior to the present settlement the grades and circles of Patwaris were never regularly defined. The pay depended on the circle and bore no relation to the qualifications of the incumbent and the amount of work to be done. The villages of a circle were not necessarily contiguous, and often lay at a great distance from each other. For *inam* and *mafi* villages a separate staff of Patwaris was employed and paid from the *dam* cess of these villages. In 1895 the Patwaris of *mafi* and *inams*—43 in number and paid Rs. 312 per mensem—were dismissed and their work made over to the Patwaris of the adjoining *khalsa* villages. These however were found unable to do the extra work, especially in Dig and Kumer, where the proportion of *inam*, *chauth*, and *mafi* holdings is very large, and thus the number of Patwaris in these tahsils was inadequate. On the other hand, in some tahsils—i.e., Akhegarh and Bhusawar—the number of Patwaris was far in excess of what was required.

71. In the course of the settlement the surplus Patwaris of such tahsils were transferred to others where the number was too few. Reorganisation of the Patwari system.

When the settlement operations in each group of tahsils were brought to a conclusion, data were available to show (1) the future income from the Patwari cess, (2) the number of Patwaris required, and proposals were put forward accordingly to reorganise and re-grade the establishment of each tahsil, improve the rates of pay, and grade each man according to his work and qualifications. In arranging the circles of Patwaris the following points have now been kept in view :—

- (1) that the amount of work should not be excessive ;
- (2) that at present the Patwaris have to perform duties in regard to collection of revenue which in British districts are performed by the Lambardars ;
- (3) that villages belonging to the same body of owners should be, as far as possible, included in one circle ;
- (4) that the villages of each circle be contiguous ;
- (5) that the pay should be sufficient to secure qualified men.

The average pay was formerly about Rs. 7-12-0 per mensem. The Patwaris have now been arranged into four grades, the pay of which is Rs. 8, Rs. 9, Rs. 10, and Rs. 11 per mensem ; the number has been reduced from 624, including the *inam* Patwaris, to 504, but the average pay has risen to over Rs. 9 per mensem, and eventually, when more men are promoted to the higher grades, will average Rs. 9-8-0 per mensem. This reform has been effected at no extra cost to the State—in fact, the monthly expenditure on salaries has been reduced from Rs. 4,938 to Rs. 4,586.

The following shows the average statistics for each Patwari's circle under the old and the new system ;—

							Former.	Present.
Total area (<i>bighas</i>)...	...	...	...	...	...	...	5,300	6,330
Cultivated (<i>bighas</i>)...	...	...	...	...	...	...	2,400	3,812
Number of fields	...	...	...	...	...	...	1,600	2,022
Number of holdings	proprietary						...	77
	tenancy						240	431
Average land revenue	...	...	...	...	...	Rs. 3,330	4,701	

The figures include *mafi* as well as *khalsa* lands. The present circles are by no means large, and the Patwaris should have no difficulty in keeping pace with their work.

During the settlement they have been instructed in surveying by the plane-table and square systems in the calculation of areas, revision of maps, and re-laying of boundaries, while the general rule that each man should prepare the records of his own circle has given all of them who were able or willing to learn a thorough knowledge of record work.

Most of the old and inefficient men have been gradually weeded out, but the difficulty of finding suitable material has often led to the retention of men who are not quite up to the work. They are weakest in surveying, and many have not yet learned to find their way quickly through a map.

72. To correct this defect and secure systematic instruction in their other duties, including the new rules and forms now prescribed, Patwari schools should be opened at Dig and Bharatpur, under the supervision of the Deputy Collectors, from June to September, under a competent instructor. Promising youths from among the Patwaris' relations or outsiders should be encouraged to come forward as candidates by the grant of small stipends of Rs. 2 per mensem. In September an examination should be held, certificates granted, and the candidates who have qualified should be registered for employment on the occurrence of a vacancy. The State Council has at my suggestion approved of this plan, and directed a school to be opened on these lines at Dig in the hot weather. Similar measures

Proposals for the training and improvement of the Patwaris.

should be taken at Bharatpur. At present most of the Patwaris know only Hindi, and their copy of the record is in that language. It is very desirable that they should know Urdu as well, and in future preference should be given to such candidates as know both.

Statistics of Patwaris and cess by tahsils.

73. The following table shows by tahsils the former and present number of Patwaris and the pay allowed to them:—

Serial No.	NAMES OF TAHSILS.	Former number of Patwaris.	Number of Patwaris who resigned or were dismissed.	Number of Patwaris newly appointed.	PRESENT NUMBER OF PATWARIS.				Former pay.	Present pay.	Patwari cess.	Patwaris' annual expenditure.
					Knowing Urdu.	Knowing Hindi.	Knowing Urdu and Hindi both.	Total.				
1	Pahari	51	13	5	33	16	49	431	430	7,315	5,504	
2	Karna	39	20	17	24	12	39	314	323	5,616	3,470	
3	Dig	44	6	11	39	13	52	404	471	6,503	5,672	
4	Kuchera	47	19	23	33	14	50	329	420	5,931	5,118	
5	Akhegarh	69	17	3	37	8	47	403	492	7,721	4,856	
6	Nagar	73	23	13	38	18	55	632	550	9,411	6,672	
7	Blaratpur	47	3	11	46	9	55	351	166	6,620	5,793	
8	Rapbas	73	23	3	45	5	53	521	593	8,169	6,936	
9	Biyana	69	13	4	34	15	49	456	438	7,764	5,456	
10	Wair	53	28	...	14	43	37	607	518	9,221	6,216	
	Total	551	172	95	5	313	155	504	4,026	4,586	73,969	57,933
	Inam	43	312	...
	Grand Total	621	4,939	...

74. The office of Kanungo, like that of Patwari, is not hereditary in Bharatpur. Before the present settlement there was an office Kanungo and one Girdawar Kanungo in every tahsil; their pay was wretchedly inadequate, some of them receiving only Rs. 6 per mensem, while the average was under Rs. 11 per mensem, and their capacity was in proportion to their pay. In the course of this settlement all the field and office Kanungos have been trained in settlement work and made to work as Munsarims.

Rai Bahadur Munshi Sohan Lal, when in charge of the Revenue Department, arranged for the appointment of two field Kanungos on Rs. 15 and Rs. 20 per mensem in each tahsil,—the rates have since been raised to Rs. 20 and Rs. 25,—and also for the payment of Rs. 20 per mensem to the office Kanungo. This had an excellent effect, as it enables us to command the services of capable men. Accordingly the old Kanungos have endeavoured to qualify themselves for retaining their posts by working in the settlement as Munsarims, and most of them have in this way obtained a good knowledge of their work. For the extra post in each tahsil one of the Settlement Munsarims has been, or will be, selected.

The present field and office Kanungos are now well acquainted with every branch of settlement and revenue work; they are well paid, and there should be no difficulty in securing well-qualified men selected either from the most capable of the Patwaris or officials trained in settlement for any vacancies that may hereafter occur. The possession of a certificate of efficiency from the Director, Land Records, Punjab or North-Western Provinces, or the passing of a similar test locally, should be insisted on.

The following table shows the number of Kanungos and their former and present pay:—

Serial No.	NAMES OF TAHSILS.	FORMER			PRESENT		
		Circlawat.	Registrar.	Pay.	Circlawat.	Registrar.	Pay.
1	Pahari	2	1	33	2	1	53
2	Kama	1	1	27	2	1	65
3	Dig	1	1	30	2	1	62
4	Kumher	1	1	16	2	1	65
5	Akheygarh	1	1	25	2	1	63
6	Nagar	2	2	31	2	1	50
7	Bharatpur	1	1	20	2	2	80
8	Rupbas	2	2	35	2	1	55
9	Bijana	1	1	17	2	1	55
10	Wair	1	1	29	2	1	53
	Total	13	12	272	20	11	606

The number has been increased from 25 to 31—the monthly pay from Rs. 272 to Rs. 606; but this increase is more than covered by the savings in pay of Patwaris. The pay as finally fixed is Rs. 20 per mensem for office Kanungos and Rs. 20 and Rs. 25 for field Kanungos. The whole expenditure can be met from the Patwar fund, which also provides for the appointment of two Sadar Kanungos—one for each Deputy Collector—on Rs. 40 to Rs. 50 per mensem.

75. I think it may be claimed that the Patwari and Kanungo agency has been raised to a high level of efficiency for a Native State, and, if properly supervised, they should have no difficulty in keeping the record up to date, preparing the annual agricultural statistics (see Appendix) now prescribed for submission to the Government of India and for the use of the State, and thus providing a continuous record-of-rights and of agricultural statistics which will enable the next settlement to be made cheaply and expeditiously.

76. As explained in Chapter I, in the course of the settlement the number of tahsils has been reduced from 12 to 10. Gopalgarh and Oochain have now disappeared. The former was amalgamated with Pahari and Nagar, while the latter was included in Akheygarh and Rupbas. Besides this, transfers of villages were made from one tahsil to another in order to adjust the boundaries and for administrative convenience.

A list showing those transfers of villages from one tahsil to another is included in the Appendices. The following table shows the years in which records were prepared and the new *jamas* introduced in each tahsil:—

TAHSILS.	Year to which entries of cultivation and rent made in the records refer.	Year from which the new jama is introduced.
Pahari, Kama, Dig, Kumher, Akheygarh, Nagar, and Bharatpur.	1897-98, corresponding to Sambat 1954.	1899-1900, corresponding to Sambat 1956.
Rupbas, Bijana, and Wair.	1899-99, corresponding to Sambat 1955.	1900-1901, corresponding to Sambat 1957.

77. Two copies of the record-of-rights have been prepared. That in Hindi for the Patwaris use has been prepared by the Patwaris themselves, and the State copy in Urdu by Muharrirs and Munsarims. It was originally proposed by Mr. Colvin to have both copies in Hindi; but it was afterwards decided, in consultation with the Political Agent and Council, to have the State copy in Urdu, as all the superior Civil and Revenue officials know Urdu, which is the office language; while many of them do not know Hindi. The latter, though the language of the people, from its poverty of expression, is a very poor medium for explaining technical terms such as occur in the *wajib-ul-arz*, *bachh*, etc. Both these copies have been carefully compared with one another and with the papers prepared on the ground. They have been checked and signed by the Munsarims and Sadar Munsarims, and finally by Circle officers. The record-of-rights contains the following documents:—

1. Field Register (*khassra*).
2. Field Map (*shajra*).
3. Genealogical tree (*shajra nasab*), with details of tenures and shares.
4. *Khewat khatauni* or *jamabandi*.
5. Register of disputes decided summarily.
6. Register of tenancy cases decided.
7. Statement of wells.
8. Statement of gardens.
9. Statement of revenue-free grants.
10. Village administration paper (*icajib-ul-arz*).
11. Order of Settlement Commissioner fixing the assessment.
12. Order of the Deputy Collector fixing the distribution (*bachh*).
13. Final proceeding.

Attempts had been made in the settlements of 1855—57 and of 1890 to prepare some of these documents, but they were usually incomplete and unattested, and it may be said that they have now been prepared for the first time.

The only difference between the Patwari's and the State copy is that the latter contains the original register of disputes and of tenancy cases, and no copies of these are in the Patwari's record. In the Patwari's copy the *shajra nasab* is on paper, while in the State copy it has been very carefully written out on long cloth (*latha*), so as to be permanently preserved. Besides the two copies of the field map with the Urdu and Hindi records, the Patwari has also been supplied with a copy on cloth for work in the field.

Difficulties in the preparation of the records.

78. In the preparation of records-of-rights we were confronted with great difficulties.

The old records of 1855—57 and 1890 being incomplete and unattested were of little help in preparing the new records-of-rights. They frequently did not contain any *khewat* or statement of proprietary rights. The entries in the *khassras* were generally incomplete or vague. In the owner's column only the names of one or two owners were usually shown, and sometimes the names of tenants were also shown in the column of ownership. As for the Patwari's annual papers they were even more incomplete and misleading.

For *masi* and *inam* estates no records were forthcoming except the rough measurement papers of 1888—90, and, as a rule, in case of dispute, columns were left blank or filled in pencil. The result was that one set of entries often contradicted the other. In fact, no regular settlement had been previously made in Bharatpur, and consequently all questions connected with proprietary and tenancy rights, revenue liability, shares in estates, tenure on which estates were held, rights of Lambardars and Mafidars, claims of deserting and absconded owners to recover their lands, rights in irrigation wells,—in fact everything bearing on the revenue administration,—was in a state of confusion, amounting to chaos. No rules had ever been formulated by the State for the guidance of the Courts or Revenue officials in dealing with such questions, and the chief—in many

cases the only—basis on which we could rely in attempting to evolve order out of chaos, by accurately ascertaining and recording rights and liabilities, of which there was no previous authoritative record, was the sense of their customary rights and liabilities, which is never found absent in the agricultural communities of India, and which, though often dimly realised, is nevertheless jealously guarded and tenaciously insisted on in case of infringement or interference.

Boundary disputes :
(c) With foreign territory.

79. In the course of the settlement the following disputes with foreign territory were decided :—

- (1) A dispute as to a small area between Bhinakpuri (Nagar) and Kherli (Govindgarh) ; the disputed area was included in Kherli.
- (2) Between the Zamindars of Basi Deo (Kama) and Mahrana (Matra district) a compromise was agreed to between both villages and the boundary of last settlement was maintained.
- (3) Between Dhadren, Khuntpuri (Bijana) and Surot, Zahirpur, and Pai of Jaipur. The disputed area was less than one *bigha* and was included provisionally in the Bharatpur State according to the previous settlements ; but the maps of the two States do not correspond. The dispute is still pending.
- (4) Between Sanghaoli (Rupbas) and Udela (Agra) disposed of on 5th September 1900 in accordance with the professional survey maps of 1857-58. With the sanction of the Board of Revenue, North-Western Provinces, the disputed area was included into Sanghaoli.
- (5) Between Kondri (Agra) and Sawantgarh (Bijana) about 8 *bighas*. The area in dispute has been included in Sawantgarh.

The only disputed boundary between Zamindars and the State was one between *rund* Heylak and Si, in which the boundary of last settlement was maintained in favour of the State *rund*.

(c) Between *khalsa* and *mafi* villages.

There was no dispute between *khalsa* and *mafi* estates.

The boundary disputes between *khalsa* villages were very few and, such as arose were easily disposed of. Village boundaries are, as a rule, well defined by stone pillars. In case of dispute the maps of last settlement were referred to, and when these did not correspond the professional survey maps of 1855-57 were taken as the basis of decision.

80. One of the most necessary and, at the same time, one of the most difficult operations in framing a complete and correct record was the settlement on permanent lines of estates and holdings which had in the past been deserted or abandoned by the owners, or which, for these or other reasons, had come under direct management (*kham*). The frequent visitations of famines in the past years, coupled with a bad revenue administration, had caused thousands of owners to abandon their lands from time to time, especially in the central or southern tahsils. Some of these migrated to foreign territory, where they settled and died, and some remained in the State ; but to escape the burden of arrears and responsibility for a *jama* which had become excessive, they preferred to cultivate as tenants-at-will in other villages rather than possess the rights and liabilities of owners in their own.

The shareholders who remained behind were made to assume responsibility for those who had deserted. This had the inevitable result of breaking down the village community still more. More and more land went out of cultivation, and the rates became so oppressive that the remaining owners either refused liability for the revenue or wantonly allowed their land to lie fallow. As a partial and short-sighted remedy for this, the State issued orders that cultivators should

not be made to pay at higher rates than owners, the revenue demand being distributed equally over all, and where the owner realised any profit rents these were liable to be confiscated by the State. The effect of this was not to improve the position of the cultivators, but to lower that of the owners.

Meantime the revenue got more and more into arrears, though attempts were made to realise not only the current demand, but the old balances; land deteriorated in value; and no one would come forward to take up deserted holdings or land put up for sale on account of arrears.

The number of owners who deserted in each tahsil and the area abandoned are shown in the following table :—

Serial No.	NAMES OF TAHSILS.	IN AND BEFORE 1877-78.			SINCE 1877-78.		
		Number of deserters.	Number of khats.	Area.	Number of deserters.	Number of khats.	Area.
1	Gopalgarh... ..	1,115	406	11,717	...	...	...
2	Pahari	95	36	521	...	...	...
3	Kama	299	239	10,635	210	175	6,923
4	Dig	453	409	10,766	183	139	4,305
5	Kumher	1,305	537	29,783	1,024	490	19,809
6	Akheygarh	545	143	19,595	603	224	21,705
7	Bharatpur... ..	745	244	8,002	927	345	13,077
8	Nagar	836	239	10,429	699	33	17,397
9	Rupbas	496	309	4,355	591	294	3,951
10	Oochain	651	161	16,159	811	276	22,692
11	Biyana	2,718	1,318	61,803	1,184	611	25,577
12	Wair	1,710	819	62,163	1,633	818	61,661
	Total	11,124	4,998	211,432	7,835	3,570	160,110

It appears that 18,959 owners, or about one-fourth of the total number, have abandoned their land since the summary settlement, and the area abandoned comes to over one-seventh of the total *khalsa* area. The tahsils of Wair, Biyana, Kumher, Akheygarh, and Oochain were in the order named those most seriously affected; the Meo tahsils suffered least, partly because the revenue was least oppressive, and partly because the population is dense and was able to maintain the cultivation.

The area of land thus deserted by the old owners was either taken possession of by relations of the deserters or by other Zamindars of the estate, or was formally transferred by the State to co-sharers or others willing to assume revenue liability, and these have now been recognised as owners. Where such schemes failed, a favourite device was to bring the estate or holding under *kham* management.

Given efficient management this arrangement, though not a desirable one, might serve as a temporary expedient. As worked in Bharatpur, where *kham* estates are managed by the Naib-Tahsildars through the local Kanungo or Patwari, generally with an eye rather to their own interests than to those of the State, the system has caused immense loss to the State and further deterioration in the condition of the villages. As an example of the abuses prevalent, I may mention a case brought to my notice in Biyana this year, where the Naib-Tahsildar had leased 50 *bighas* of land for annas 8 per *bigha*, for which the Tahsildar had no difficulty in obtaining Rs. 3-4-0 per *bigha*, and that, too, paid in advance.

One of the many evils in the old assessments was that where an estate was *kham* or deserted a nominal *jama* was fixed and no steps were taken to arrange

for its future payment, the result being an enormous accumulation of arrears in such cases. Every case of a *kham* estate or holding has now been taken up and arrangements made for the abolition of the *kham* system from the new assessment. Where, as generally happens, the old owners agreed to accept a fixed assessment and could show their ability or give security to pay it, the land was settled with them in whole or in part, and where they refused or were unable to accept liability arrangements have been made with other agriculturists.

The main obstacle to the successful settlement of these lands was that of liability for past arrears. Till the Zamindars knew how these were to be disposed of, no promises could induce them to accept responsibility. In nearly all cases I therefore fixed the amount of arrears to be remitted and to be realised to start with, and fixed instalments for the latter spread over the term of settlement. Once this difficulty was overcome the task was a comparatively easy one. The following table shows the number of estates and holdings hitherto managed *kham* which have now been permanently settled :—

Serial No.	NAMES OF TAHSELS.	Number of whole estates.	Number of villages in share.	Total area.	Cultivated.	Old jama.	REMARKS.
1	Pahari	4	...	2,316	702	821	Managed kham.
2	Kama ... ..	...	...	...	...	...
3	Dig	1	...	2,506	33	44	
4	Kumher	6	7	13,412	7,255	7,572	
5	Akheygarh ... ..	...	4	1,423	976	954
6	Nagar	1	...	524	237	1,165	
7	Bharatpur	4	4	8,257	1,395	2,030	
8	Rupbas	3	4	7,335	4,193	5,055	
9	Biyana	1	...	6,030	1,679	2,670	
10	Wair	6	6	23,571	11,801	19,723	Sir Sirkar and Ballabgarh managed kham.
Total ...		26	20	71,574	23,433	42,143	

It will be seen that no less than 26 whole estates and shares, amounting to 20 estates, have now been successfully settled; the proprietary rights have been defined; and the land revenue, now fixed for the term of settlement, has been accepted by the Zamindars. This settlement has been effected by restoring the proprietary rights in the whole area, or as much of it as they could manage, to the owners, and assisting them with *takavi* advances for the purchase of oxen and seed. Failing this, the land has been made over to other agriculturists of the same or neighbouring villages. There are now only the following *kham* estates in the State:—(1) Bharatpur Khas, (2) Srinagar, (3) Kumher Khas, (4) Sir Sirkar (Wair), (5) Ballabgarh, and (6) Mandal Pahari. In (1) to (4) the State is direct owner, and the Zamindars have only a right to cultivate. In all of these cases however cultivating leases at a fixed rent have been given for the term of settlement, so the demand is not fluctuating.

The estate of Ballabgarh belongs to the Jagirdar, and as the *jagir* will be restored sooner or later the *kham* management must continue till then. Mandal Pahari, a small submerged area, is the only really *kham* estate.

-81. In addition to the special difficulties above referred to, the absence of any reliable or attested records in the State caused a general difficulty in deciding disputes as to proprietary and occupancy rights and tenures of, and shares in, estates. The question of tenancy rights

will be discussed in Chapter VIII. Mutation of names owing to death, desertion or transfers had never been attested, and hence the action taken to frame a complete and correct record-of-rights brought all the latent disputes to a head. These disputes were, as a rule, summarily disposed of by Deputy Collectors, and their decisions were recorded in registers specially prepared for the purpose, which now form part of the settlement record. The most important cases which required special investigation were decided in separate files by the Deputy Collector, who referred to me freely for instructions in cases of doubt, and appeals against their orders were heard by me. The following table shows the number of disputes decided summarily, the result of appeals, and the fees realised :—

Serial No.	NAMES OF TAHSILS.					CASES DECIDED.				APPEALED AGAINST.				FEES ON SALES AND MORTGAGES.	
						Every kind of property dispute.	Sale.	Mortgage.	Cultivation.	Total.	Instituted.	Decided.		Total.	Realised.
												Accepted.	Rejected.		
1	Pahari	...	...	...	...	342	1	29	62	434	...	...	...	63	63
2	Kama	...	...	...	...	299	3	29	16	345	3	1	2	561	561
3	Dig	...	...	...	...	672	23	72	42	809	11	4	7	21	21
4	Kumher	...	...	...	...	459	12	110	...	580	6	1	5	4,055	4,059
5	Akheygarh	...	...	...	...	202	5	10	2	225	1	1	...	341	160
6	Nagar	...	...	...	...	512	4	95	141	755	3	...	3	1,326	371
7	Bharatpur	...	...	...	...	221	4	48	7	280	1	...	1	6,615	4,717
8	Rapbas	...	...	...	...	169	5	73	10	256	8	1	7	7,942	914
9	Biyana	...	...	...	...	329	11	39	...	378	25	9	16	12,352	3,743
10	Wair	...	...	...	...	269	5	23	23	319	3	...	3	1,131	1,117
	Total	...	...	...	...	3,490	73	536	312	4,411	61	17	44	35,310	16,332

In the enquiry many cases of alienations by sale and mortgage were brought to light which had not been registered at the time and had not paid the fees of 10 per cent. on the consideration to the State. The rate of fees was reduced with the sanction of the Darbar from 10 to 5 per cent., and after all such cases had been disposed of a list was prepared showing the fees to be realised, and orders were issued to have these recovered through the tahsils. The total demand for these mutation fees is Rs. 35,310, of which Rs. 16,230 have been already realised. The rest will be realised within the present *rabi* or the coming agricultural year. The amounts were so heavy in several villages, especially of the Biyana tahsil, owing to the great number of mortgages among co-sharers, that it was found desirable to fix instalments spread over two years for their payment. It will be observed that out of 4,411 disputes disposed of summarily, only 61 were appealed against, of which 44 were rejected and only 17 accepted.

82. In addition to the disputes the following table gives similar details Disposal of regular cases. of cases disposed of by separate files :—

Serial No.	NAMES OF TAHSILS.	Details.	CASES DECIDED.											APPEALED AGAINST.			
			Proprietary right.	Occupancy right.	Partition.	Sales and mort- gages.	Formation of chaks.	Management of abandoned lands	Other cases.	Miscellaneous.	Kulliat.	Realisation of fee on sale and mortgage.	Total.	Instituted.	Decided.		
															Accepted.	Rejected.	Pending.
1	Pahari ...	Decided.	151	56	41	23	...	...	160	710	...	...	1,180	11	6	5	...
2	Kama	"	65	21	10	37	...	2	14	132	217	35	642	8	...	8	...
3	Dig	"	63	36	13	11	7	12	7	111	258	36	648	0	1	5	...
4	Kumhar ...	"	78	20	4	79	33	47	16	141	214	35	667	8	...	8	...
5	Akheygarh ...	"	66	3	4	11	1	42	46	122	54	20	378	30	1	2	...
6	Nagar	"	131	82	49	5	1	...	125	975	...	...	1,369	13	3	10	...
7	Dharatpur ...	"	123	11	14	31	62	20	95	546	...	...	650	15	9	4	2
8	Rupbas	"	170	36	30	72	20	8	146	455	...	...	930	15	4	10	1
9	Bijana	"	119	22	30	24	2	6	104	535	691	...	1,533	9	1	6	2
10	Wair	"	55	3	4	6	14	149	7	104	151	01	558	4	2	2	...
Total			1,023	314	208	299	147	285	812	3,570	1,495	198	8,058	92	27	60	5
			0	3	53	5	5	...	8	35	5	...	414	...	...	...	...

These cases, as a rule, involved important issues relating to tenures of estates, proprietary rights in whole estates, or disputes as to the property between Zamindars and Mafidars of revenue-free estates, cases of partition, and complicated claims for occupancy rights, etc. As an example of the labour involved in disposing of some of them, I may instance the case of Pathana in Tahsil Akheygarh. The history of this old and bitter dispute between the State and the Mafidar, which had been pending for the last thirteen years, is given in para. 57 of my Report on the Central Tahsils. It involved the confiscation or restoration of the *mafi* and proprietary rights of several hundred shareholders in an area of about 9,000 *bighas* and the disposal of arrears amounting to about Rs. 20,000. In the investigation 327 old records were consulted; and I am happy to say that, thanks largely to the tact and judgment of M. Hira Singh, it was finally decided without any friction, to the great satisfaction of the Darbar and of the Mafidars. Out of 8,658 cases disposed of by regular suit, only 92 were appealed against, of which 29 appeals were accepted and 63 rejected. Of the 414 cases shown as pending on 15th February, many have since been disposed of. The balance consists chiefly of realisation of fees and partition cases instituted after the new records were completed. These will be disposed of by the Revenue Deputy Collectors.

83. In order to maintain an accurate record after the settlement, it is essential that all changes of proprietary and occupancy rights should be brought to light, and after necessary enquiry given effect to in the annual records. Hence as the new records of each tahsil were completed mutation registers were opened for the record of such changes and rules laid down for the disposal of the cases by the different classes of Revenue officers. The system is working well, but will require careful watching till it has taken firm root. The following table shows the number of mutation cases decided by Sadar Munsarims and Deputy Collectors after completion of the new records in the northern and central tahsils and the fees realized :—

Mutations.

Serial No.	NAMES OF TAHSILS.	CASES DECIDED.						FEES TO BE REALISED ON SALES AND MORTGAGES.	
		Cases of inheritance.	Cases of partition.	Sales.	Mortgages.	Miscellaneous.	Total.	Total fees.	Realised.
1	Pahari	79	...	...	...	...	79	20	...
2	Kama	471	5	1	60	42	579	124	63
3	Dig	496	...	2	1	...	499	125	39
4	Kumber... ..	...	...	...	...	...	...	...	...
5	Akheggarh	144	...	4	...	16	164	38	5
6	Nagar	295	...	...	...	...	295	75	...
7	Bharatpur	143	3	3	5	23	177	37	...
8	Rupbas... ..	...	...	...	...	...	...	...	...
9	Biyana ... ..	...	...	...	...	...	...	...	...
10	Wair	31	...	1	...	...	32	8	...
	Total	1,662	8	11	66	61	1,828	427	106

The cases are chiefly simple ones of inheritance. The rules recently issued by the State to restrict alienations—which will be referred to in the next chapter—have considerably reduced cases of sale and gift.

The system followed in mutation cases is that in force in the Panjab. The original form is in Urdu; the Patwari has a register in Hindi; orders are passed by the attestation officers on the original form, which is then sent to the tahsil for record; and an abstract of the order is made by the Patwari in his register and given effect to in the annual papers.

84. In the course of the settlement and at its close the following statements, registers, and reports have been made over to the State Council and Revenue Office:—

Documents to be made over to Council.

(1). Settlement records of each estate *khalsa* and *mafi*, including the documents mentioned in para. 77. These have been well bound in leather, and arranged in the record-room by tahsils in topographical order.

(2). The incomplete maps and records prepared in previous settlements, which have been bound in one volume for each village and placed with the preceding.

(3). Other papers, original *chithas*, or rough copies prepared on the ground at the present settlement.

(4). Lists of State lands showing the area and the departments in charge.

(5). Statement of the old and new *jama*, by tahsils and estates.

(6). Statement of arrears to be realised and to be remitted for *khalsa* villages, showing the instalments fixed in case of realisations.

(7). Similar statement of arrears due from *Mafidars*.

(8). *Kistbandi* of the new *jama* showing *jama*, cesses, etc., and the *kharif* and *rabi* instalments.

(9). Statement B by tahsils, summarising the statistics and assessment data of each estate, and containing my original order giving reasons for fixing the new *jama* and disposing of the arrears of each village.

(10). Village note-books bound in volumes by tahsils, which embody all the information available as to area, wells, cultivation, rents, population, ploughs, cattle, and realisation of revenue from the summary settlement up to date, and contain a detailed account of the village resources written by the Deputy

Collectors, and a copy of my order of assessment. Further explanation of this important document is given in the next paragraph.

(11). Copies of my printed assessment and final reports and the original reports of the Deputy Collectors and Mr. Pyster regarding their tahsils.

(12). List of instructions issued during the settlement.

(13). Copies of the Patwari and Kanungo Rules and of the new Revenue Manual (under preparation.)

(14). Copies of the *Mof* Registers (to be prepared when the enquiry is completed).

84A. The original Statement B, with manuscript and printed copies of the assessment and final reports, will be made over to the Agency office, together with all English correspondence relating to the settlement. They should be kept separate so as to be readily available at next settlement.

The village note-book contains the following information :—

(A) Statistics—

I.—*Milan Rakba* or statement of areas, showing details of area at the last and present settlements.

II.—*Jinsicar* or crop statement, showing the crop grown at last settlement, in the 5 years preceding the present settlement, and in the year of settlement.

III.—*Jama Wasil Baki*, showing the demand, realisations, and balances of the various settlements since 1855.

IV.—Showing sales and mortgages from 1855 up to the settlement of 1890-91 and from 1890-91 up to date.

V.—Statement of cultivating occupancy, showing area cultivated by owners and the various classes of tenants in the present settlement.

VI.—Statement of rents, showing the area held and the total and average rents paid by the various classes of tenants on different classes of soil in the present settlement.

VII.—Statement of tenures, showing the number of estates held by the different tribes, with details of area and *jama* in the present settlement.

VIII.—Statement showing population, houses, carts, ploughs, and cattle in 1890-91 and the present settlement.

IX.—Statement showing details of wells and well areas in 1890-91 and present settlement.

(B) *Halot Dehi* or general account of the village with special reference to assessment prepared by the Deputy Collectors after personal inspection of the village.

(C) Assessment remarks by Settlement Commissioner based on the above statistics and his personal inspection.

(D) Abstract of method adopted for distributing the new *jama*.

These note-books should remain in the custody of the Deputy Collectors so as to be always available for reference.

85. Hitherto the system of record has been anything but satisfactory.

Record-room. There were several record-rooms lying at a great distance from one another and from the various State offices. The records and record-rooms of the Inam Department and those of the *Punarth* or

Mafi Department were separate from one another and from those of the Revenue Department. No attempt had ever been made to weed out or arrange them, and no proper registers were maintained. Hence when any file was called for, there was great difficulty and delay in getting at it, and frequently it could not be traced at all. No rules existed for destroying the old and unnecessary papers. Hence the records increased to unwieldy dimensions, through the tortuous mazes of which it was almost impossible to follow out the point in dispute to a clear issue. The whole system was chaotic, and caused not only inconvenience to all departments, but frequently grave injustice as well.

The State has now decided upon and begun the task of a radical reform. The Settlement office, which is commodious and conveniently situated outside the Mattra gate, has been converted by the Public Works Department into a splendid record-room. All the revenue records from the different offices have been brought together, and are now being arranged in separate *bastas* for each village. For convenience of reference each village bundle is divided into three sections, relating to—

- (a) Settlement cases ;
- (b) *Inam* and *mafi* cases ;
- (c) Other revenue cases.

Rules have also been issued for the destruction of old and unnecessary papers, and this work is proceeding *pari passu* with the re-arrangement of the records. The bound settlement records have been neatly arranged by talisils in a separate section of the same building under the care of the Record-keeper. The arrangement will enormously facilitate work and secure proper custody of the records now prepared with such expenditure of time and labour.

86, In Bharatpur it has hitherto been the custom that all litigation relating to rights in land, excluding tenancy cases and claim for specific relief, were disposed of by the Civil Courts. This would be unobjectionable did the State possess the adequate machinery. My experience of the actual working of the system was that the Nazims who dealt with the cases in the first instance or on appeal from the Tahsildars, and the Civil Judge who disposed of appeals from the Nazims, owing to their ignorance of the revenue system—an ignorance not unnatural under the circumstances—were not the proper agency for the work. In nearly every case that came before me the most simple issue had been complicated by unnecessary enquiries into side issues ; the investigation was needlessly protracted to the great inconvenience of the parties and their witnesses ; and when a decision was given, it had no finality, as none of the courts was in a position to secure a real grasp of the facts. Hence the Nazim's order was appealed to the Civil Judge, who frequently reversed it, or directed a new enquiry ; the Judge's order was appealed to the Dewan and the Council, with the result that the issues which should have been fixed at the start were often fixed for the first time by the final court of appeal, and the whole enquiry had to begin all over again. I therefore suggested that the proper agency for disposing of the litigation relating to land was that of the Deputy Collectors. There are now two qualified men who having worked throughout the settlement, have an intimate local knowledge of the State and of revenue conditions. They control the Tahsildars, Kanungos, Patwaris, and the land-revenue agency generally, through which such cases must usually be investigated ; they have direct access to the settlement and annual records, which have been and will be prepared under their supervision ; they are or should be continually on tour in their respective circles, and therefore in a position to take up the cases locally, thereby securing a more thorough enquiry and a more speedy decision. These views commended themselves to the State administration, and all litigation relating to rights in land has now been withdrawn from the Civil and made over to the Revenue Courts. The system will, I am sure, work well ; and I have here recorded the reasons for the change, as it is possible that attempts may be made hereafter to revert to the old arrangement.

owner would now take from the cultivator if rents were paid in kind. If, therefore, we take one-third of the value of the *chahi* crops and two-fifths of the value of other crops as already ascertained, the result will represent the owner's share, and two-thirds of this will represent the State share, which, as already settled, is now limited to two-thirds of the net assets.

Taking the owner's share as above ascertained to represent the net assets, the State demand at two-thirds of the assets is represented by two-ninths of the value of the *chahi* and four-fifteenths of the value of all other crops. The results have been worked out in Chapter VI of the Assessment Reports, and though based on a series of hypotheses they were found to be one of the most useful and reliable estimates available.

110. Applying the same method of calculation to each kind of soil, we can deduce (1) the total value of the produce, (2) the owner's share or net assets, *viz.*, one-third for *chahi* and two-fifths for other crops, (3) the State share at two-thirds of the owners' share; and dividing the result by the total area of cultivation in each class we arrive at (1) the value of the produce per *bigha*, (2) the value of the owners' share per *bigha* or rent-rate, (3) the value of the State share per *bigha* or revenue-rates, which, if applied, would bring out the State demand as above shown.

111. In spite of the fact that nearly half of the cultivated area is held by tenants-at-will paying cash rents, these rents, taken as a whole without discrimination, were of little use as a guide to the assessment. Even where the genuine rents were disclosed they were often non-competitive and did not represent the full letting value of the land. The reasons for this have been stated in the assessment reports and are equally operative in all tahsils. To some extent the lowness of the rents as compared with the *jama* is a genuine fact and is due to (1) the high pitch of the assessment; (2) the great agricultural depression that followed the famine of 1877-78 and re-appeared again during the last 5 years; (3) the desertion of owners and tenants, which resulted in large areas being left derelict or managed *kham*, which the owners or the State are glad to get taken up on very easy terms; (4) the want of competition for land owing to the extensive areas of waste and the comparative scarcity of tenants; (5) the past policy of the State in prohibiting or discouraging the owners from realising more than the State demand from the cultivators; (6) the recent drought has temporarily changed much land usually *chahi* into *barani*, and lowered the rents to a corresponding degree; (7) there has been a great increase in the *barani* cultivation within the last few years, and tenants who break up waste are allowed very lenient rents, generally 4 annas per *bigha* for the first few years.

Besides these genuine reasons for the lowness of rents, there is another explanation, *viz.*, that the full rents have not in many cases been recorded. Some notorious instances of this were brought to light in several villages in Rupbas. In one of these the owners realised at the rate of Rs. 2-8-0 per *bigha*, while in the *bachh* they showed the tenants as having paid only 8 annas per *bigha*. This was done with the connivance of the tahsils' officials, who shared in the profits. Again, in the more fertile tracts of Biyana, Rupbas, and Oochain, it is not uncommon for the owners to realise from 8 annas to Re. 1 per *bigha* as profit from the tenant at the time of giving him a lease to cultivate, while he is shown as paying only at "owner's rates" or even something less. Several of these cases came to my knowledge during my tours and increased my suspicions as the cash rents being so low as the recorded figures showed.

112. With a view to ascertain the true competitive cash rents special enquiries were made by the circle officers in selected and representative villages in which from one reason or another competitive rents were taken, and there was some probability of getting the correct figures. This special attestation was carried out with some success in Kama, Dig, Kumher, Bharatpur, Rupbas, Oochain, and Biyana, and the results and the conclusions derived from them have been described in Chapter VII of the Assessment Reports.

In the remaining tahsils either no separate enquiry was made, or the data were not sufficient to generalise upon. Over a large part of the State, therefore, the estimate based upon two-thirds of the cash rents would have resulted in a reduction of the old demand.

113. This is a problem with which nearly every Settlement Officer is confronted when dealing with village communities in which owners themselves work a large proportion of the area, and that generally the best. In my Alwar report I have shown that similar conditions exist in that State, though the revenue is generally lower, the people more prosperous, and owing to the dense population the demand for land greater than in Bharatpur. The three British districts adjoining Bharatpur are Gurgaon, Mattra, and Agra. They were assessed over twenty years ago, and their position then as regards the cash rents was much the same as that of Bharatpur now, as the following extracts from the Settlement Reports prove.

The Settlement Officer of Agra in proposing a demand higher than was justified by the recorded rents, the genuineness of which was apparently not open to doubt, wrote thus (para. 10, Settlement Report):—

“A detailed examination of the rent-rates of the estates has completely convinced me that as yet nothing like the full rent, which it is possible for a tenant to pay, is taken as a rule by the landlord. Competition has not taken the place of custom in determining the rent, and rack-renting is utterly unknown.”

The Settlement Officer of Gurgaon in paragraph 20 of his report says:—

“Hitherto the great majority of the tenants paying cash rents have been holding at customary privileged rents which had their origin in the days when the land was plenty and the cultivators were few. During the past few years however, and especially since the announcement of the new assessments, there has been a marked tendency on the part of the owners to insist on their right to receive larger rents.”

In the Fatehpur Sikri Tahsil, which adjoins and is very similar to Bharatpur, the actual average rental was even then Rs. 3-12-0 per acre, or Rs. 1-8-6 per Bharatpur *bigha*, while the actual recorded rate now in Bharatpur is only Rs. 1-3-9 per *bigha*.

Similarly, in reviewing the assessment of the Cis-Jamna Tahsils of Mattra, —adjoining Kama, Dig, Bharatpur and Kumer,—the Government of the North-Western Provinces wrote in 1880:—

“If a fixed and low rent be the highest good of a tenancy, the system sanctioned by tradition in these Cis-Jamna parganas secures it. The peculiarity is that the tenants in many of these *bhayachara* villages are not required to pay more than the share of the Government revenue and village expenses that is proportionate to the land held by them. They hold as it is termed at revenue rates. In these estates the bulk of the land is cultivated by the members of the brotherhood themselves. The surplus land alone is held by tenants; and as the only contribution required from cultivating proprietors by the village council is their quota of the land tax and other expenses, the custom grew up of dealing with any tenants there might be in the same way. The distinction between rent proper and revenue is thus obliterated or rather unknown in these *bhayachara* villages. Here the important point to observe is the salutary effect of this system of revenue rates in preventing, as Mr. Whiteway (Settlement Officer) says, any but the actual cultivator deriving any profit from the land.”

The difficulties with which I have been confronted in assessing these tahsils are exactly the same as those above described. A large portion of the land does not pay rent, being cultivated by the proprietors themselves. A further portion is held by privileged or leniently-assessed tenants paying little more than the State dues and village expenses. The proprietary bodies are numerous, and for the most part poor. They rely for subsistence less on rent than on the profits of their own cultivation. For the same reasons that in Chhata (Mattra) the Settlement Officer, though the standard of assessment was half-assets, fixed a revenue demand of Rs. 2,02,933 on a recorded rental of Rs. 3,07,419, and in Kosi a demand of Rs. 1,67,040 on a recorded rental of Rs. 2,10,495,—thus taking

Table showing new chakks formed with jama and area.

Serial No.	Name of Tahsil.	Number of vil- lages in which chaks have been leased.	Number of chaks.	AREA ALLOTTED.						JAMA NOW FIXED.						Irrigated from jama.	AREA BROUGHT UNDER CULTIVATION AFTER GIVING CHAKS ON LEASE.				Area to be managed.	
				Chahi.	Sairabi.	New tal- low.	Old tal- low.	Uncul- turable.	Total.	Rainfed 1930.	Sairabi 1937.	Sairabi 1939.	Sairabi 1939.	Sairabi 1940.	Sairabi 1941.		Chahi.	Sairabi.	Bairabi.	Total.		
1	Pahari ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2	Kana ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3	Dig ..	4	4	..	..	3,697	4,277	580	4,277	305	1,085	1,501	2,173	2,173	2,001	2,745	141	..	..	013	013	..
4	Kamhor ..	21	22	25	..	12,457	12,613	..	12,613	2,052	3,825	5,412	7,718	7,718	8,210	8,007	1,450	22	..	1,623	1,823	2,301
5	Akhoygarh ..	1	3	45	20	1,308	1,600	21	1,600	..	370	553	730	730	810	810	..	20	..	630	630	..
6	Nagar ..	1	1	..	380	2,451	2,834	43	2,834	1,012	1,300	2,085	2,085	2,085	2,085	2,085	1,012	..	..	409	409	..
7	Bharatpur ..	44	62	88	431	31,021	32,606	457	32,606	8,757	11,457	15,672	17,007	17,007	17,580	17,580	8,003	813	1,530	7,730	10,403	2,083
8	Rupbas ..	16	20	28	7	12,621	13,634	608	13,634	..	2,555	3,617	5,088	5,088	5,810	5,810	..	125	318	2,593	2,736	..
9	Biyaan ..	3	7	130	346	2,183	2,763	93	2,763	..	495	953	1,353	1,353	1,591	1,591	..	133	15	1,145	1,293	1,001
10	Wair ..	10	0	219	100	10,830	12,308	402	12,308	..	4,238	4,611	5,764	5,764	5,764	5,764	..	143	678	912	1,763	..
Total ..		100	128	683	1,179	77,201	82,483	2,104	82,483	12,156	25,403	34,426	42,017	42,017	41,538	40,269	10,852	1,308	2,841	15,783	19,923	5,383

119. In fixing the new assessment it was necessary to take account not only of the old demand and the two general cesses—*viz.*, Patwar cess Rs. 3-2-0 per cent. and local rate Rs. 4-11-0 per cent.—on the land revenue, which have been maintained unaltered, but also of the various miscellaneous cesses and imposts (known locally as *lags*) which have been tacked on the *jama* from time to time. The chief items were (1) percentage on the *jama* levied for arrears prior to last settlement, (2) subscriptions to temples, (3) instalments payable to Mahajans for advances in the famine of 1877-78, (4) resumption of part of the owner's estimated profits or of the *lambardari* dues for some past misconduct, (5) subscriptions for the Ramlila fair and for the purchase of Ganges water to wash idols, and (6) charges for roadside grazing and the cultivation of waternuts, etc. etc. Details for each tahsil are given in Chapter VIII of the Assessment Reports, and the items are varied and curious. The incidence of these petty items was generally arbitrary and unequal. They complicate the accounts and furnish a bad precedent, which the officials of Native States are only too ready to lay hold of, for the imposition of new imposts. The instalments for old arrears have ceased with the remission of the arrears as explained in Chapter II. The Darbar at my suggestion agreed to the abolition of all the remaining charges as apart from the land revenue, and to arrange for payment of them, where such was expedient, from the State Treasury.

The total remission in each tahsil works out as follows :—

						Rs.
Gopalgarh	...	...	...	...	...	3,978
Pahari	...	...	...	...	...	3,169
Kauna	...	...	...	...	...	4,158
Dig	...	...	...	...	...	5,662
Kumher	...	...	...	...	...	3,497
Akheygarh	...	...	...	...	...	3,229
Bharatpur	...	...	...	...	...	6,195
Nagar	...	...	...	...	...	3,854
Rupbas	...	...	...	...	...	4,066
Oochain	...	...	...	...	...	3,122
Biyana	...	...	...	...	...	3,899
Wair	...	...	...	...	...	5,827
Grand Total						50,651

This remission should be set off against the increase in the land revenue demand on re-assessment.

120. In future the items of demand will be very simple, being limited to—

- (1) the land revenue;
- (2) local rate at Rs. 4-11-0 per cent., or 3 pies per rupee;
- (2) patwar cess (*dami*) at Rs. 3-2-0 per cent., or 2 pice per rupee; and in certain villages,
- (3) instalments on account of arrears since 1890;
- (4) water-rate on land irrigated from State works where this has not been taken account of in the assessment.

These make up the demand due to the State, besides which there is a special cess levied as *malba* for village expenses. To complete this chapter these two latter charges may be explained.

121. The *sairaba* demand or water-rate represents the charge on all lands irrigated by dams, channels, and other distributaries constructed by the State. At last settlement lands which were *sairaba* at the time—*i.e.*, inundated by any of these sources—were assessed as such, and no provision was made for charging a separate rate in case of future extensions of irrigation.

The development of the irrigation system, so successfully carried on by the Executive Engineer within the last six years, has greatly increased the area benefited by and the efficiency of the inundations, and since 1897, when the results of the new management began to be appreciable, the State has imposed

CHAPTER V.

RESULTS OF RE-ASSESSMENT.

124. Before applying the various estimates of the new assessment described in Chapter IV., which are of a more or less hypothetical nature, it will be convenient to summarise the practical considerations for and against enhancement.

The following table shows the increase or decrease in cultivated area, wells, *chahi* and *dahri* area, ploughs, prices, and population as compared with last settlement:—

TAKSIL.	Culti- vated area.	Crop area.	CHAHÍ AREA.		MASONRY.		Kacha wells.	Ploughs.	Prices.	Population.
			Hal.	Total.	Wells.	Laos.				
Gopalgarh ...	+16.5	+11	-25	-9	-27	-27	Not known.	+35	5 per cent.	
Pahari ...	+9	+7	Not known.	+13	-7	-20	...	+45		
Kama ...	+12	+22	...	+15	+7	+16	+130	+35		
Dig ...	+27	+32	...	+32	+12	+12	NIL.	+46		
Kumber ...	+18	+14	-10	-1	+18	-7	-7	+14	NIL.	
Akheygarh ...	+5	+6	-22	-16	-2	-7	+31	+13		
Bharatpur ...	+27	+31	-12	+11	+10	-14	-8	+21		
Nagar ...	+17	+22	-6	-4	+5	-10	+47	+41		
Bupbas ...	+16	+39	-17	-5	+85	+11	+273	+16	NIL.	
Oochain ...	+19	+1	-21	-16	+3	+11	-2	+17		
Biyana ...	+5	-4	-13	-11	-3	+5	-22	+4		
Bhusawar ...	+2	+1	-20	-19	+5	+11	+29	+21		
Balabgarh ...	+6	+7	-9	-5	+32		
Total of State, ...	13	13.5	-2

Owing to the incomplete or inaccurate character of the statistics of the 1890 Settlement, the data for ascertaining the subsequent increase or decrease are not always quite satisfactory. This much is however clear, that for the whole State there has been a substantial increase—from 13 to 14 per cent. in total cultivation and area of crops sown; that there has been a decrease, though only temporary, in the number of working masonry wells and *laos*; an increase in the number of *kacha* wells, and a falling off in the total *chahi* area and the area irrigated within the year, but this decrease is largely owing to the recent drought and may be regarded as temporary. There has been a very large apparent increase of ploughs—but the figures of last settlement are doubtful—and a slight decrease of 2 per cent. in population, but this is caused by the falling off in urban population, and the rural population has risen slightly. Prices, for reasons already stated, have not increased for purposes of assessment.

Among more general considerations for and against enhancement the following may be urged:—

For—(1) a great improvement in the revenue administration since 1895, and especially during the progress of settlement, *viz.*, the correct definitions of the rights of the Zamindars, the limitation of their liabilities to the State, great security of property and safeguards against exactions, and, above all, the settlement on a sound basis of deserted holdings and *kham* estates;

- (2) the remissions of the enormous arrears prior to 1890,—over 43 lakhs,—and all payments in liquidation thereof;
- (3) the remission of most of the arrears since 1890; and the arrangements made to realise the sums to be collected by easy instalments;
- (4) the steady development of the irrigation system, and the restoration and extension of the *bands* on which the State has spent several lakhs since 1895;
- (5) the disappearance of the wild cattle nuisance which harassed Bharatpur, Kumber, and parts of Dig, Rupbas, and Oochain;
- (6) the abolition of a great number of extra cesses, the reduction of the rate and amount of *malba*, and the reform of the *lambardari* system;
- (7) the general inclusion in the assessment of water-rate on *sairaba* lands, where it was formerly separately levied;
- (8) the large amount of waste land still available in the central and southern tahsils, which is being steadily broken up.

- Against*—(1) The land revenue had already been enhanced between 1855 and 1899 from Rs. 14,16,000 to Rs. 19,10,000, *i.e.*, by 35 per cent., owing to frequent re-assessments for short terms;
- (2) the condition of the people owing to agricultural calamities and gross maladministration deteriorated steadily between 1876 and 1890, and it is only within the last few years that it has shown signs of recovery;
 - (3) in consequence of (2) even the assessment of 1890 has not been paid in full except in the northern tahsils and in Nagar; and even in these there were slight arrears in 1898-99 and heavy arrears owing to the famine of 1899-1900;
 - (4) the assessment of 1890-91 was heavy in the remaining tahsils, and oppressive in Rupbas and Bhusawar as well as in many individual estates of all tahsils;
 - (5) 58·5 per cent. of the cultivation is dependent solely on the rainfall, which, though fairly abundant on an average of years, is subject to great fluctuations from year to year, while the winter rains are very uncertain;
 - (6) though 22·5 per cent. of the area is secured by wells a large proportion of these are brackish or bitter, which, unless aided by rainfall, tend to deteriorate the soil, and the drought of recent years has reduced the water-supply in all wells and thrown a great number out of working;
 - (7) the new cultivation is often in inferior lands, and most of it was assessed as fallow at last settlement at from 2 to 8 annas per *bigha*;
 - (8) many village communities have not recovered from the famine of 1877-78 and do not possess enough hands or cattle to work their lands fully, they have also been much straitened by the recent drought;
 - (9) owing to the want of cultivators, especially in the central and southern tahsils, there is little competition for land and rents are low;
 - (10) the crops are in many places damaged by wild animals,—deer, *nilgai*, pig, etc.,—and in the sandy tracts close to the Banganga and Gambhir, by field rats.

The problem of assessment was to so adjust the above considerations to the estimates of assessment referred to in the preceding chapter as to work out an equitable demand based on the principle that the State share is two-thirds of the estimated net assets (except on *chaouth* and *istamarri* holdings).

125. The following table shows for each tahsil (1) the old demand alone and including cesses now abolished; (2) the theoretical new demand brought out by the various estimates; (3) the assessment proposed in each case; (4) the assessment as actually announced, *i.e.*, the sum total of the village assessments:—

Estimate.	No.	Gopalgarh.	Pahar.	Kauna.	Big.	Kumher.	Akheygarh.	Bharatpur.	Nagar.	Rupnagar.	Ocellah.	Miyana.	Bhuwar.	Ballaigarh.	Total.
Old demand (land revenue)	..	2,19,040	1,23,717	1,38,294	1,35,401	1,35,713	1,43,544	1,43,881	90,007	1,05,835	1,72,703	2,05,972	2,36,488	31,413	10,00,153
Old demand with cesses abolished	..	2,48,020	1,27,220	1,42,512	1,44,510	1,30,240	1,40,773	1,50,010	93,801	1,10,451	1,82,837	2,10,230	2,45,400	35,221	10,76,336
Summary ratio of last settlement	..	2,83,400	1,33,588	..	..	1,82,403	1,60,702	1,80,745	1,08,168	1,58,745	2,11,782	2,09,301	2,45,331	32,710	..
Soil rates	..	2,83,087	1,34,101	1,41,869	1,63,070	1,66,600	1,58,850	1,68,000	1,00,718	1,30,472	2,03,230	2,01,203	2,41,275	31,400	..
One-fourth of the net produce	..	2,80,130	1,41,202	1,73,821	1,65,601	1,58,171	1,55,123	1,70,007	1,02,174	1,03,032	1,84,887	2,14,301	2,36,770	33,427	..
By kind rents—State share = 3 owner's share.	..	2,04,428	1,48,198	1,80,072	1,67,532	1,58,171	1,52,016	1,70,470	1,04,783	1,07,839	1,81,830	2,08,466	2,30,701	31,860	..
By recorded cash rents State share = 3 owner's share.	..	1,90,215	1,50,770	1,34,124	1,10,212	1,10,093	1,17,515	1,10,307	63,021	79,839	1,37,331	1,30,263	1,71,189	25,136	..
By specially allotted cash rents	1,05,480	1,40,773	1,50,710	..	1,56,426	..	97,325	1,60,207	1,84,652	..	..	..
(a) Proposed in assessment reports.	..	2,80,000	1,38,000	1,57,000	1,53,000	1,55,000	1,50,000	1,60,000	1,03,000	1,11,000	1,87,000	2,17,000	2,36,000	30,000	20,85,000
(b) As announced.	..	2,82,025	1,38,603	1,57,400	1,56,163	1,52,089	1,47,663	1,56,268	1,04,402	1,08,431	1,82,275	2,15,430	2,37,606	30,000	20,64,387
Final	..	do.	do.	do.	do.	1,50,808	1,49,063	1,60,503	1,06,786	1,12,321	1,86,475	2,18,300	2,30,830	do.	20,96,208

Thus according to the assessment reports, which deal only with the *khalsa* villages and do not include the leases of waste land, the demand of the year prior to assessment was Rs. 19,00,158, and including cesses abolished or included in the *jama* Rs. 19,76,336. The new demand proposed by me was Rs. 20,85,000, and the demand as actually announced was Rs. 20,64,387, rising by progressive assessment in certain villages in certain tahsils to Rs. 20,96,208 in the sixth year, at which amount it will remain for the remaining term of settlement. My reasons for fixing the new demand are fully explained in the assessment reports and the letters reporting the announcement of the new *jama*, which have been printed as appendices to the reports. Progressive assessments were given to villages (1) in which the assessment was considerable, and it would be impolitic to demand it in full

at once, or (2) which, owing to temporary depression, were at present unable to pay a full *jama*, but were likely to be able to do so after a few years.

The soil rates adopted to work out the new demand in each tahsil were as follows:—

NAMES OF TAHSIL.	CHABIL.						Khalil.	SAIRADA.				Bhur.	Total demand on cultivation.	Average on cultivation.	New fallow.	Banjar.	Total demand on fallow and banjar.	Grand total of demand by proposed rates.
	Hal.			Sairada.	Sabika.	Dartah.		Average.										
	Permanent.	Temporary.	Hal.															
Gopalgarh ...	2 12 0	2 12 0	...	1 8 0	2 7 0	...	2 4 0	1 8 0	1 15 3	1 0 0	0 8 0	280,000	1 10 11	0 8 0	...	2,439	2,82,439	
Pahari ...	2 4 0	2 4 0	...	1 8 0	1 15 6	...	2 0 0	1 6 0	1 6 3	1 0 0	0 8 0	138,000	1 3 8	0 8 0	...	1,442	1,39,442	
Kama ...	2 4 0	2 4 0	...	1 4 0	1 14 0	...	2 0 0	1 4 0	1 4 1	0 15 0	0 10 0	157,000	1 2 0	0 8 0	...	283	1,57,283	
Dig { Khalen ... Chauth ...	2 2 0	2 2 0	...	1 4 0	1 14 6	...	2 0 0	1 3 0	1 2 0	1 2 4	0 14 6	130,000	1 2 0	0 4 0	...	863	1,30,863	
Kumber ...	0 15 0	0 15 0	...	0 8 0	0 13 4	...	...	0 7 0	0 7 0	0 7 0	0 5 4	0 4 0	23,000	0 8 2	0 2 0	...	126	23,126
Akheygarh ...	2 0 0	...	...	0 15 6	1 9 11	...	...	0 13 0	...	...	0 13 0	0 8 0	1,47,715	1 0 11	0 4 0	1 0	9,424	1,57,140
Bharatpur ...	2 4 0	...	...	1 11 6	2 2 1	...	1 0 0	...	...	...	0 13 0	0 8 0	1,45,664	1 2 6	0 4 0	...	4,701	1,49,705
Nagar ...	2 2 0	...	...	1 2 0	1 12 0	...	1 8 0	1 2 0	...	...	0 13 0	0 8 0	1,63,279	1 3 0	0 4 0	2 0	6,784	1,60,953
Rupbas ...	2 0 0	...	...	1 8 0	1 14 6	...	0 15 0	0 15 0	...	...	0 15 0	0 10 0	1,04,252	1 0 9	0 4 0	...	861	1,05,244
Oochain ...	2 12 0	2 4 0	3 0 0	1 8 0	2 5 0	1 10 0	1 10 0	1 4 0	1 4 0	1 5 1	1 0 0	0 13 0	1,07,230	1 4 8	0 4 0	1 0	4,423	1,11,553
Bynna ...	2 8 0	2 4 0	3 0 0	1 4 0	2 5 4	1 12 0	1 12 0	1 0 0	1 2 0	1 8 4	0 14 0	0 10 0	1,84,544	1 8 0	0 4 0	1 0	2,930	1,57,474
Bhusawar ...	3 0 0	2 4 0	3 4 0	1 8 0	2 8 4	2 8 0	1 10 0	1 6 0	1 2 0	1 8 11	0 12 0	0 8 0	2,11,870	1 7 10	0 4 0	0 0	5,080	2,16,950
Ballaigarh ...	2 13 0	2 0 0	3 0 0	1 3 0	2 6 9	2 0 0	1 8 0	1 2 0	1 2 0	1 7 0	0 12 0	0 8 0	2,20,231	1 5 3	0 4 0	...	5,682	2,31,951
	3 4 0	2 8 0	3 4 0	1 8 0	2 13 3	...	...	1 2 0	1 2 0	1 2 0	0 12 0	0 8 0	31,183	1 10 3	...	...	...	31,183

126. These rates have been compared with one another and with those of adjoining British Districts and Native States in the assessment reports and need not be further discussed here.

As the twelve tahsils shown in the preceding table have now been reduced to ten, and there have been considerable changes in the boundaries, it will be convenient to show for the tahsils as now constituted the old and new demand, with details of progressive enhancement, and also of (1) *khalsa* villages, (2) *kham* villages, and (3) leases of State lands. This is done in the following table:—

Statement showing new jama.

Serial No.	Name of Tahsil	Detail	Old Jama. 1867-68 or 1858-59	NEW JAMA.						
				Sambut 1896. 1901-02	Sambut 1897. 1901-01	Sambut 1898. 1901-02	Sambut 1899. 1902-01	Sambut 1900. 1903-01	Sambut 1901. 1904-05	Sambut 1902. 1905-06
1	Palari	Fixed	216,224	231,150	231,150	231,150	231,150	231,150	231,150	231,150
		Mandal Kham	177	379	379	379	379	379	379	379
		Total	216,401	231,529	231,529	231,529	231,529	231,529	231,529	231,529
2	Kama	Fixed	1,43,757	1,53,057	1,53,057	1,53,057	1,53,057	1,53,057	1,53,057	1,53,057
		Fixed	1,43,757	1,53,057	1,53,057	1,53,057	1,53,057	1,53,057	1,53,057	1,53,057
		Total	1,43,757	1,53,057	1,53,057	1,53,057	1,53,057	1,53,057	1,53,057	1,53,057
3	Dag	Fixed	1,51,878	1,59,057	1,59,057	1,59,057	1,59,057	1,59,057	1,59,057	1,59,057
		Dakarkho (Kham)	...	1,220	2,750	2,750	2,750	2,750	2,750	2,750
		Chaks	...	305	1,085	1,501	2,173	2,693	2,785	2,785
4	Kham	Fixed	1,23,512	1,41,632	1,41,632	1,41,632	1,41,632	1,41,632	1,41,632	1,41,632
		Quila Kham	3,775	4,585	4,762	5,022	5,333	5,333	5,333	5,333
		Kham Chaks	...	2,052	3,425	5,412	7,715	8,210	8,600	8,600
5	Alteygarh	Fixed	2,19,167	2,14,800	2,17,226	2,17,411	2,17,509	2,19,402	2,20,752	2,20,752
		Chaks	...	...	...	...	...	...	...	...
		Total	2,19,167	2,14,800	2,17,226	2,17,411	2,17,509	2,19,402	2,20,752	2,20,752
6	Nagar	Fixed	2,50,725	2,51,374	2,51,374	2,51,374	2,52,799	2,52,799	2,52,799	2,53,500
		Chak Sardaul	...	1,012	1,250	2,045	2,645	2,656	2,685	2,685
		Total	2,50,725	2,52,386	2,52,624	2,53,419	2,55,444	2,55,455	2,55,484	2,56,185
7	Bharatpur	Fixed	1,28,440	1,41,198	1,41,198	1,41,215	1,42,823	1,42,823	1,43,273	1,43,273
		Chaks	11,277	7,750	8,419	8,752	9,125	9,125	9,125	9,125
		Total	1,40,217	1,48,948	1,49,617	1,50,000	1,51,948	1,51,948	1,52,398	1,52,398
8	Rupnar	Fixed	2,27,111	2,27,111	2,27,111	2,27,306	2,27,511	2,27,611	2,27,741	2,27,741
		Chaks	101	101	101	2,555	3,617	5,045	5,816	5,816
		Total	2,27,212	2,27,212	2,27,212	2,29,861	2,31,128	2,32,656	2,33,557	2,33,557
9	Biyana	Fixed	2,06,601	2,06,601	2,15,805	2,15,805	2,15,975	2,15,975	2,15,975	2,15,975
		Chaks	...	...	933	1,353	1,591	1,652	1,652	1,652
		Total	2,06,601	2,06,601	2,16,738	2,17,158	2,17,566	2,17,627	2,17,627	2,17,627
10	Wair	Fixed	2,22,376	2,25,305	2,17,508	2,17,185	2,17,560	2,17,627	2,21,602	2,23,402
		Chaks	...	...	4,298	2,20,167	22,012	2,20,632	6,595	6,598
		Total	2,22,376	2,25,305	2,21,806	2,19,392	2,39,572	2,38,259	2,28,197	2,30,000
11	Ballabgarh	Fixed	31,643	31,643	30,000	30,000	30,000	30,000	30,000	30,000
		Fixed	18,500	19,051	20,082	20,082	20,115	20,115	20,115	20,115
		Kham	15,029	13,699	10,021	10,021	10,021	10,021	10,021	10,021
12	TOTAL	Fixed	31,643	31,643	30,000	30,000	30,000	30,000	30,000	30,000
		Chaks	101	12,257	25,405	31,426	42,017	44,535	46,263	46,263
		Total	31,744	43,900	55,405	61,426	72,017	74,535	76,263	76,263

* It does not include Rs. 690 of chauth jama in Ajan Rs. 500 and Karmwan Rs. 190.

† It includes Rs. 315 on chauth jama in Niewara, but does not include Rs. 470 of Jhalera and Mandal paid to the Mafdar as it is included in *mafi*.

‡ It includes Rs. 375 of Mahloni deducted from *mafi jama*. The *jama* of chak Sanwargarh not included.

127. The figures show some slight variations from those in the preceding paragraph owing to the clearing up of certain doubtful points as to *khalsa* and *masi* lands in Pathana, and a few minor corrections. But the figures now given may be considered final. They show that (1) excluding the leases of waste the demand has been raised from Rs. 19,09,665 to Rs. 20,60,023 in 1900-1901 and Rs. 20,92,369 in 1905-1906—an initial increase of Rs. 1,50,358, or 8 per cent., and a final increase of Rs. 1,82,704, or 9·5 per cent.; and (2) including the leases of waste land the demand has risen from Rs. 19,09,766 to Rs. 20,85,428 in 1900-1901 and Rs. 21,38,638 in 1905-1906—an enhancement of Rs. 1,75,662, or 9 per cent. initial, and of Rs. 2,28,872, or 12 per cent. final. Against this enhancement must be set off miscellaneous cesses now abolished to the extent of about Rs. 60,000.

128. After the assessment proposals for each tahsil had been formulated, the assessments for each estate were worked out by me with the aid of the Circle officers, and a note showing why and how the result had been arrived at was recorded opposite each estate in Statement B. In this note the disposal of the arrears in each case is also shown, and all other matters relating to the village assessment, *viz.* the amount due on *khalsa* and *masi* lands,—whether water-rates have been included in or excluded from the *jama*,—have been cleared up. This working out of the assessment village by village was the most tedious and laborious part of the settlement, but the notes recorded by myself and the Circle officers in our village to village inspections much facilitated it.

The standard rates were freely departed from where circumstances justified such a course, and on this point local knowledge as to the condition of the estate and the resources of the people was essential.

129. The village assessments when thus worked out were announced by me, in the presence of the Political Agent and one or more Members of the Council, to the assembled Lambardars and other representatives of each tahsil as follows:—

Northern Tahsils—at Dig in August 1899;

Central Tahsils—at Bharatpur in October 1899;

Southern Tahsils—at Bharatpur in August and at Biyana in December 1900.

I think out of 1,397 estates there were only two in which the assessments were not based largely on my own local inspections. I do not claim any special merit for this village to village inspection, but it inspired confidence in the people, and gave me a firmer grasp of the question of assessment. As shown in Chapter II all previous assessments had been made by a Committee at headquarters who had no local knowledge and were absolutely dependent on the information supplied to them by Tahsildars who were frequently either corrupt or incompetent.

The new assessments were in every case readily accepted by the Zamindars, who received at once *pattas* in Hindi explaining all details of the new demand, while in token of acceptance they signed or sealed the *kabuliyaats* or Urdu counterparts containing the order of assessment, which have been included in the settlement record. There was no refusal to enter into the new engagements, and, as far as I am aware, not a single petition or appeal against the assessments has been preferred to the Darbar or to the Agent to the Governor-General. In one estate—Jhanjar (tahsil Nagar)—I have arranged for a reduction of Rs. 500 on the *jama* originally imposed, as water is no longer available for the cultivation of rice on as large a scale as formerly. No doubt the remission of the old arrears, and the fixing of easy instalments for the amounts which it was decided to collect as described in Chapter II, helped considerably towards this satisfactory result, but I think that the people realised that at last the State had decided to deal fairly and honourably by them, and after the successive short-term assessments, made on no system except that of squeezing as much as possible from the land-holders, the fixing of

a reasonable demand for a term of twenty years was looked as a guarantee that the State had now adopted a policy which in the long run will prove beneficial to both parties.

129A. In explanation of the pitch of the new assessment and the manner in which it should be worked, I reproduce the following extract from my letter No. 2713, dated 16th January 1901, to the Political Agent, Eastern Rajputana States:—

"15. The fiscal results of the re-assessment will therefore be an immediate enhancement of about Rs. 1,75,062 and a final enhancement of over Rs. 2,28,872 in the land revenue demand, and whereas the average realisations under the old assessment fell short of the demand by nearly a lakh of rupees a year, I am confident that the new demand being judiciously apportioned between estates and fairly distributed among the shareholders within them, will, if a proper revenue system is maintained and adequate suspensions of revenue are given in years of distress, be realised on the whole fully and punctually. The new assessment represents a full two-thirds of the net assets, and over and above it local rate and cesses amounting to Rs. 7-13-0 per cent. are realised by the State, as well as instalments for arrears in most of the villages in the central and southern tahsils.

"Taking all these into account the new assessment probably comes to three-fourths of the net assets or estimated rental, which, though not excessive by the standard of Native States, is distinctly high, and is certainly 50 per cent. higher than in any British district of the assessment of which, I am in a position to speak. The Bharatpur State is fortunate in possessing perhaps the finest peasantry in Rajputana, not excepting even Alwar. That the gross mismanagement of the revenue administration in the past has not demoralised them is the most eloquent testimony to this fact. The manner in which they have hitherto endeavoured to meet their liabilities, though often grievously oppressive, under circumstances the most discouraging, is to me a marvel. Given fair play in ordinary years and reasonable consideration in seasons of distress, I am confident that not only will they be able to meet the demands of the settlement now introduced, but at its termination will have so developed their resources and strengthened their position as to be able to bear a further enhancement at least in the central and southern tahsils.

"17. The first regular settlement and re-assessment of the State may be said to synchronise with its coming under direct administration. Under existing circumstances the term of the new settlement will expire about the time when His Highness the present infant Maharaja may be expected to take over the administration, and if the principles which I have attempted to indicate are followed during the long period of minority, the Imperial Government may look forward to making over to him a State second to none in Rajputana in the solvency of its finances and the prosperity and contentment of its people. If I may be allowed to touch on a matter foreign to the land revenue assessment, but intimately connected with the well-being of the people, I would suggest that as soon as the finances of the State permit, the present oppressive duties on import and export of nearly all forms of agricultural produce which paralyse trade and are a dead weight on the producer should be remitted.

130. Before the present settlement the dates of realising the revenue instalments were:—

Kharif { 1st instalment, 15th *Magh Badi*, about 25th November.
2nd instalment, 15th *Pok Badi*, about 25th December.

Rabi { 1st instalment, 15th *Baisakh*, about 25th April.
2nd instalment, 15th *Jeth Badi*, about 25th May.

These dates were only nominally adhered to, and realisations often commenced in October for the *kharif* and early in April for the *rabi*.

A State watchman (*shahua*) was usually posted in every village at harvest time to see that the crops were not removed before payment of the demand. In my report on the Northern Tahsils the following dates were provisionally sanctioned:—

Kharif { 1st instalment, 25th November.
2nd instalment, 25th December.

Rabi—One instalment, 15th May.

Experience has shown that from the State point of view these dates are rather late, and the Tahsildars are inclined to anticipate them.

Therefore, after further consideration of all aspects of the question and consultation with the State Council and Revenue authorities, the following dates were finally fixed for the whole State;—

Kharif { 1st instalment, 15th to 30th November.
2nd instalment, 15th to 31st December,

Rabi—One instalment, from first to the end of May.

These dates are suitable both for the people and the State, and should be rigidly adhered to; the present custom of anticipating them is a most pernicious one, though always favoured by the Tahsildars, and should on no account be allowed.

131. The proportions payable for *kharif* and *rabi* have been fixed for every estate with reference to the area and value of the two crops *kharif* and *rabi*. Amounts payable in estate with reference to the area and value of the two crops *kharif* and *rabi*. and to the wishes of the revenue-payers, but if it is found necessary to amend them hereafter the Deputy Collectors should report the matter to the Council and obtain sanction. If, for instance, the *kharif* cultivation much exceeds the average owing to favourable rains or other causes, while the area sown for the *rabi* falls short of the average, in such cases if the Zamindars agree, they may be allowed to pay something above the fixed instalment in the *kharif*, the excess being credited against the *rabi* demand. This should, however, be left to their own discretion, except in cases when the people are bad payers, or when it is feared that the *rabi* cultivation will be seriously contracted. If such be the case the Tahsildars should report the matter to the Deputy Collector and obtain sanction to collecting an excess amount in the *kharif*.

132. Before the new *jama* was announced there were frequent complaints of over-realisation against the Patwaris and Lambardars. Measures to be taken to prevent over-realisation. The reason was that there existed no permanent method of distribution. The *jama* was generally redistributed every year by shares or over the cropped area by soil or all-round rates. No owner or tenant knew his liability beforehand. The amount to be collected and the method of its distribution were left entirely to the discretion of Patwaris and Lambardars, who after discharging the State demand often misappropriated the surplus.

* The new demand has now been worked out for every holding separately, and every owner and every tenant paying at owners' rates has received a slip (*parcha*) giving the details and total for his holding. This will protect the people against extortion and over-realizations by the Patwaris and Lambardars. The subject is explained at more length in the following chapter.

CHAPTER VI.

Former and present methods of distribution.

133. The following table shows the various methods of distribution employed in past years and as now fixed :—

Serial No.	NAME OF TAHSIL.	Number of villages.	Detail of distribution.	ZAMINDARI.		DISTRIBUTION BY SHARES.		DISTRIBUTION ACCORDING TO POSSESSION.			State property.
				Pers.	Joint.	Ancestral.	Customary.	Soil rates.	All-round rates.	Separate rate on cultivable and banjar.	
1	Palasi ...	134	Former... Present...	1 1	3 1	... ...	... ...	31 31	89 61	... 47	......
2	Kama ...	122	Former... Present...	1 1	1 1	24 13	... ...	4 25	67 31	22 49	3 3
3	Dig ...	120	Former... Present...	2 2	2 1	24 ...	... ...	28 17	37 14	13 60	4 4
4	Kumbher ...	115	Former... Present...	2 ...	... ...	23 9	... ...	8 3	39 1	27 100	3 3
5	Alkhyrath ...	112	Former... Present...	1 ...	3 5	61 6	3 ...	12 16	5 ...	7 66	......
6	Nagar ...	171	Former... Present...	2 2	7 7	... ...	... ...	83 62	65 21	14 69	......
7	Bharatpur ...	150	Former... Present...	2 3	5 7	3 ...	... ...	17 18	118 5	... 112	5 5
8	Hoplas ...	147	Former... Present...	6 6	29 19	61 13	2 1	16 65	39 7	4 36	......
9	Biyana ...	165	Former... Present...	... 1	32 31	69 8	42 1	16 23	9 1	8 102	1 1
10	Wair ...	125	Former... Present...	7 3	... 1	93 18	... ...	62 26	3 ...	... 97	......
Total ...		1266	Former... Present...	25 21	73 73	295 69	47 2	267 316	479 134	95 747	16 16

From this it appears that under the old system one-third of the estates distributed the *jama* by shares, and another third distributed by an all-round rate on cultivation. The former system was more general in the southern tahsils; the latter in the northern tahsils and in Bharatpur.

134. Both systems are very faulty. The distribution by an all-round rate on cultivation is obviously unequal and unjust. The basis was not the cultivated area of settlement, but the actual cropped area of the year or harvest. In most villages fallow land (*jadid*) was also included, and in some there was a separate rate also for culturable (*kadim*) in the possession of individual shareholders, especially if it grows reeds (*sarkanda*) or thatching grass (*gandar*). In some villages it was customary to have a separate *bachh* in each harvest, viz., a uniform rate for all *kharif* crops, and soil rates on *chahi*, *sairaba*, *barani* for *rabi* crops.

The *bachh* might be varied from year to year or from harvest to harvest, and this generally lay in the discretion of the Lambardars, Patwaris, and Tahsildars, who decided how much of the old arrears were to be collected. Irregular items were also included now and then. Thus the Zamindars, instead of settling beforehand with the tenants the rents payable by the latter, left the matter over till the *bachh*, and then fixed rates of distribution which, after discharging the State demand, would leave themselves a greater or less margin of profit. This was a villainous system, as no one knew his liability beforehand, and caused frequent complaints of over-realisation, etc.

135. The general system of distributing revenue liability by shares where proprietary rights are based on shares, though specious enough at first sight, is radically unsound and has been the cause of the ruin of hundreds of shareholders and of

holdings being abandoned and left derelict. Such a distribution to be equitable pre-supposes (1) that the original partition of the land by shares was made equally and justly, but in Bharatpur this is very far from being the case, as the strongest shareholders seized the best land and wells prior to and retained them on partition; (2) that since the original partition there has been no change of any importance in the relative revenue-paying capacity of the holdings. But this assumption, too, is far from correct, for in a tract like this, subject to considerable river action, and also much dependent on wells, this factor cannot remain constant over a term of years. One shareholder's well is bitter; or it runs dry, or collapses, and he is not in a position to renew it; or his land gets sanded over by a Bangan-ga flood, and goes out of cultivation; and yet he is compelled to pay the same amount of revenue as a shareholder who has none of these disadvantages to contend with. No wonder that under such a blind rule-of-thumb system desertions have been numerous, for a great number of shareholders were placed under a distinct disadvantage.

The fact is that in former assessments no attention was given to the distribution of the State demand. The people were in theory left to arrange this themselves, which in practice meant that it was arranged for them by the Patwari with the aid of one to two pushing Lambardars or shareholders who had their own ends to serve. They have now come to recognise the evil results of the old system; and the first question asked when arrangements are on foot for the settlement of the deserted holdings is whether the new *jama* will be distributed as before by shares—in which case no offers would be forthcoming—or by rates on the different classes of soil according to quality. When reassured on this point they were generally found willing to undertake responsibility. Even in joint estates the co-sharers were found anxious to pay for the lands in their separate occupation by soil rates. Of course in such cases the first step should be a partition, but from this they have been hitherto deterred by the high fees charged and the trouble and delay involved. There are many large and unwieldy estates, still nominally joint, in which partition is absolutely necessary to put things on a proper footing, and special arrangements will be made for this as soon as possible.

136. As the Patwaris and Lambardars who profitted by the old system were opposed to any change, we had at first great difficulty in fixing the new methods. The principle was however adhered to, that where a distribution by shares or all-round rates gave rise to inequality suitable soil rates should be framed to work out the new demand. The rates were invariably framed in consultation with the Zamindars, occupancy tenants, and other revenue-payers, and once they began to realise the fairness of the system all open opposition ceased. In fact the first application usually made by the people on hearing the new *jama*, was that it should be distributed by soil rates on the land in their possession. Disputes sometimes arose as to these rates, e.g., (1) some wanted one rate for all the *chahi* lands, others asked for differential rates according as the wells were sweet or bitter; (2) others again applied to have *chahi* on *kacha* wells assessed at lower rates than on masonry wells; (3) some wished for one rate on all *barani*, while others called for a lower rate on *bhur*. The points in issue were discussed with them by the Deputy Collector, and, as a rule, the objections were finally overcome and mutual agreement secured. Where this was found impossible the Deputy Collector finally fixed the rates, but such cases were extremely few.

In the new distribution only 90 villages, or less than 7 per cent., adhered to shares, and 134 villages, or 10 per cent., have adopted an all-round rate on cultivation, while 1,063 villages, or over three-fourths of the total number, have agreed to a distribution by soil rates on *chahi*, *sairaba*, *barani*, etc. The only appeal preferred against the method of distribution was from Heylak in Kumber, and this was rejected.

137. The method of distribution in case of progressive assessment will generally follow that of the initial assessment. But in cases where, owing to waste land being broken up, or the area of *chahi* having increased before the final demand is reached, a revision may be necessary; this can be made with the sanction of the Deputy Collector.

Where leases of waste land have been given the demand is usually progressive, and it is hoped that most of the area will have been brought under cultivation in the course of a few years before the final demand is reached. The lessees have generally agreed to pay according to their shares in the area leased. The *jama* will therefore continue to be realised by shares for the term of settlement, unless the Zamindars apply for a revision and agree to some other method.

138. The following shows the year on the area of which the *bachh* was

Area on which *jama* is made in each tahsil :—
distributed.

NORTHERN TAHSILS.

	Year.	
Pahari	1897-98	} Including also the area of waste land broken up in 1898-99.
Kama	"	
Dig	"	
Kumher	"	
Akheygarh	"	
Nagar	1897-98	} In some estates on the area of 1897-98, and in some on the area of 1898-99.
Bharatpur	"	
Rupbas	1898-99	} Including also the area of land broken up in 1899-1900.
Biyana	"	
Bhusawar	"	

Thus the *bachh* has in nearly all cases been made on the area actually under cultivation at the time when the new assessment was brought into working, and is therefore well up to date.

139. The principles adopted for the assessment of *sairaba* lands have been described in Chapter IV, and they should be very carefully given effect to by the Revenue Department.

Those which require special attention are—(1) that all *mafi* and *inam* land irrigated from dams and channels shall pay water-rate on such area, unless exempted by special order of the State; (2) that in *khalsa* villages where the water rate has not now been included in the *jama*, it shall be charged on the area annually irrigated and cropped; (3) that when the total area irrigated in any village exceeds in any year the area assessed as *sairaba* at settlement, water-rates will be charged on the excess area. By the irrigated area assessed as such at settlement is meant the area so assessed in the *bachh*, and this should be taken as the basis of all calculations, except in the cases where my order of assessment distinctly specified that I have assumed a certain area as *sairaba*. (4) If any land has been newly irrigated, but has derived no benefit as regard the crops from such irrigation, the water-rate will be remitted; if the benefit is slight, a partial exemption will be allowed.

In special cases when, owing to continued failure of irrigation or a change in the direction of the flood, the assessment has become excessive, it may be revised by Deputy Collectors with the sanction of the Council, and in such cases, too, the *bachh* may be revised and the *jama* re-distributed. If the area now assessed as *sairaba* in the settlement remains uncultivated in any year owing to submerging, the fixed *jama* will not necessarily be altered, as the submerging is, as a rule, only temporary and will prove very beneficial to the crops of the next harvest. But if the submerging seriously damages the crops, remission or suspension of the current demand should of course be allowed with the sanction of the State Council.

140. The annual *bachh* will generally be in accordance with the settlement *bachh* except in joint *zamindari* estates, where it will vary from year to year according to the area cultivated by the co-sharers. If the land now assessed as cultivated goes out of cultivation or deteriorates in quality owing to wells collapsing or going out of work, the *jama* will not be subject to revision. But where damage or deterioration is due to natural causes, such as the action of *nalas* or streams, reduction of *jama* should be allowed till the land is restored to its former condition. Similarly, where waste land is brought under cultivation, or *barani* land becomes *chahi*, no charge will be made in the fixed assessment, the main object of which is to encourage such improvements by giving a fixed demand for a long term of years.

The *bachh* as now fixed in *pattidari* and *bhayachara* estates will not be subject to revision except in the cases already referred to. In joint estates the *bachh* must be revised annually. This is a tedious and troublesome system, and in itself is calculated to produce many other disorders. In all joint estates and estates nominally partitioned into two or three *pattis*, partition should be encouraged, so that a permanent method of distribution may be fixed on the bases of separate liability.

141. In fixing the methods of distribution the rent payable by occupancy tenants has been defined usually at owner's rate with or without an addition as *malikana*. In some estates the tenants have hitherto paid rent at owner's rate; in others at other rates or a fixed sum as settled by mutual agreement. In joint estates the owners generally realise from tenants a rent in excess of the owner's rate. The great source of difficulty in the old system was that in allotting the land to tenants for cultivation the owners rarely settled the rates of rent beforehand, and at the time of realisation they endeavoured to exact as much as possible. This gave rise to many complaints of over-realisation. To prevent such disputes it has now been arranged:—(1) where the rent has been fixed by a written lease (*patta*) or (2) where it has been fixed orally by mutual consent, and recorded after enquiry from both parties in the *khasra tip* by the Patwari, effect will be given to such lease or agreement—whatever the rates—as between the landlord and tenant; but (3) in other cases where there is no lease and mutual agreement is not proved by the record of rents in the *khasra tip*, the owner shall be only entitled to rent at owners' rates. This provision, will, it is hoped, lead to rents being fixed according to (1) and (2).

The following table shows the rates of *malikana* imposed on occupancy tenants in each tahsil:—

Serial No.	Names of Tahsils.	NUMBER OF VILLAGES AND RATES OF MALIKANA.																				
		Rs. a. p.			Rs. a. p.			Rs. a. p.			Rs. a. p.			Total.								
		0	0	6	0	1	0	0	1	0	2	0	0		3	0	0	4	0	0	5	0
		Per rupee of land revenue.																				
1	Pahari ... ..	...	15	...	4	...	44	...	1	...	...	...	...	...	...	...	...	...	...	...	63
2	Kama ... ..	...	10	...	...	...	6	...	...	...	...	...	...	...	...	...	...	...	...	...	17
3	Dig ... ..	...	5	...	...	...	16	...	...	...	...	...	...	...	...	...	...	...	...	...	28
4	Kumher ... ..	...	13	...	...	...	16	...	...	...	...	...	...	...	...	...	...	...	...	...	30
5	Akheygarh ... ..	...	6	...	...	...	13	...	...	...	...	...	...	...	...	...	...	...	...	...	19
6	Nagar ... ..	...	24	...	9	...	67	...	...	...	...	...	...	...	...	...	...	...	...	...	100
7	Bharatpur ... ..	...	2	...	2	...	69	...	...	...	...	...	...	...	...	...	...	...	...	...	62
8	Rupbas ... ..	...	14	...	...	...	53	...	...	...	...	...	...	...	...	...	...	...	...	...	67
9	Biwana	1	32	...	3	...	12	...	...	...	...	...	...	...	...	...	...	...	...	...	48
10	Wair ... ..	...	9	...	...	...	12	...	...	...	...	...	...	...	...	...	...	...	...	...	21
	Total	1	130	...	18	...	297	...	1	...	3	...	5	...	...	...	...	...	...	...	453

The *malikana* allowed to owners varies from $\frac{1}{2}$ anna to 8 annas per rupee over and above the revenue and cesses, but the general rate is from 1 anna to 2 annas per rupee. The high rate of 8 annas per rupee has been allowed in five *chauth* estates of Dig in which the State demand is only one-fourth of the net assets. If the *malikana* were limited to 1 or 2 annas per rupee, the profits of the favourable *chauth* assessment would have been transferred to the tenants.

142. The practice hitherto followed in Bharatpur was that the owners were not held responsible for realisation of *jama* due on tenants' holdings, but both owners and tenants were equally responsible for the demand on the area cultivated. As the rights of owners and tenants have now been fully defined, and the owners are allowed to realise from tenants at more than the owner's rate, they will be held responsible for payment of the *jama* due on lands held by tenants-at-will, whether they have realised the rent from the tenant or not. As occupancy tenants pay at owner's rate with or without *malikana*, they will, as a matter of convenience, be responsible for paying the State demand on their holdings, and in case of default are liable to ejectment subject to the rules now laid down. In case of ejectment the holding and the revenue liability will revert to the owner.

CHAPTER VII.

REVENUE ASSIGNMENTS.

143. The following statement shows the total and cultivated area held in *inam* and *mafi* by various tribes in each tahsil, the nominal assessment according to the present settlement, the actual demand on account of cesses payable to the State, the total arrears due from the *mafidars* up to re-assessment, and the disposal of these arrears:—

Tahsils.	PATTY MAJIS.			WHOLE VILLAGES.			GRAND TOTAL.		Nominal jama.	CESSES PAID.								ARREARS.				
	Number of villages.	Total area.	Cultivated area.	Number.	Total area.	Cultivated area.	Total.	Cultivated.		Dami.	Local rate.	Chair Haziri.	Chanda.	Bhet.	Lag Sadabart.	Nazrana.	Hund.	Lag Kannugol.	Total.	Total.	Remitted.	To be realised.
Fabari	86	3,413	3,300	...	...	...	3,413	3,300	3,821	120	...	507	...	...	...	...	...	...	687	646	125	520
Kann	46	6,305	4,645	8	13,379	10,132	18,064	15,077	10,674	631	199	652	0	...	...	...	...	...	1,380	651	136	515
Dig	67	14,188	10,214	50	113,082	89,013	128,170	99,827	62,878	1,065	173	...	...	...	...	...	...	...	14,482	33,847	8,055	25,793
Kumhar	56	6,803	3,828	37	51,012	31,086	58,605	34,014	40,574	1,208	322	4,039	17	62	...	...	...	...	6,008	28,414	14,800	13,614
Akhoggarh	25	960	829	17	20,408	21,086	27,121	21,015	26,627	833	480	331	27	22	3	600	...	...	2,750	6,002	12	5,990
Nagar	83	2,811	2,553	0	5,001	4,737	8,772	7,300	9,709	305	60	442	11	0	...	...	...	00	885	...	7	843
Dharapur	91	22,021	14,987	29	25,108	14,007	47,189	28,984	34,000	1,053	183	4,735	2	200	...	...	...	...	6,373	29,688	10,190	19,498
Rupbas	51	4,054	4,014	13	19,440	10,859	24,100	14,873	21,537	673	321	404	11	41	...	...	...	...	1,543	3,125	87	3,038
Diyana	30	4,500	3,533	21	26,118	16,070	30,763	19,600	32,838	1,026	517	531	31	45	...	...	...	...	2,170	3,777	47	3,730
Wair	77	8,829	6,061	11	21,506	14,030	30,335	20,991	36,080	1,127	489	370	9	29	...	...	21	...	2,370	9,678	793	8,885
Total	623	73,660	54,783	201	303,636	211,629	377,295	260,400	2,85,452	8,021	2,777	23,884	114	838	3	699	24	60	38,947	1,10,377	34,252	83,125

The following table shows for the whole State the area held by each class of grantees—Thakurs of the 16 *kothris* (descendants of Maharaja Badan Singh), Sinsinwar Jats, Rajputs, Gujars, Brahmins, etc.:

Detail.	THAKURS OF 16 KOTHIS.				SINSINWAR JATS.			OTHER JATS.			GUJARS.			BRAHMIN.			TEMPLES.			RAJPUTS.			MISCELLANEOUS.			TOTAL.		
	Number of villages.	Total area.	Cultivated area.	Number of villages.	Total area.	Cultivated area.	Number of villages.	Total area.	Cultivated area.	Number of villages.	Total area.	Cultivated area.	Number of villages.	Total area.	Cultivated area.	Number of villages.	Total area.	Cultivated area.	Number of villages.	Total area.	Cultivated area.	Number of villages.	Total area.	Cultivated area.	Number of villages.	Total area.	Cultivated area.	
Petty grants ...	3	183	129	67	23,438	19,379.58	0.011	5,008.60	4,435	3,106	164	13,035	9,171	123	11,366	9,567	7	540	483	142	11,452	7,980	623	73,000	54,783			
Whole villages ...	23,41,868	25,727	86	140,725	310,387.10	17,178	11,064.11	32,457	23,880	23	18,403	12,429	27	37,076	20,570	1	101	69	10	9,937	6,204	201	303,635	211,026				
Total ...	27,42,051	25,856	153	172,103	129,666.77	23,736	17,032.70	30,893	26,956	187	32,638	21,607	156	48,142	30,416	8	641	552	152	21,270	14,274	824	377,255	266,409				

Thus about 11 per cent. of the *chauth* and revenue-free area is held by the decendants of Badan Singh, 46 per cent. by Jats of the Sinsinwar *Göt* to which the ruling family belongs, 6 per cent. by other Jats, 10 per cent. by Gujars, 9 per cent. by temples, and the remaining 18 per cent. by miscellaneous grantees. If we exclude the *chauth* grants, which represent not revenue-free lands, but lands leniently assessed, the *masi*, *inam* and *jagir* area is decidedly small for a Native State, and the explanation of this has been given in Chapter II, *viz.*, the Chiefs for the last century at least have steadily pursued the policy of resuming such grants under one pretext or another.

144. The common forms of revenue-free grants
Kinds of *masi*. of land are:—

A.—Land given in charity (*punarth*).

B.—Land given in consideration of service (*chauth*, *inam*, *iwaz-khidmat*).

C.—Other *masi* and *jagir* grants.

These are sub-divided as follows:—

A.—(1) Land given to charitable institutions, such as temples, *Piyans*, etc.

(2) Land given to charitable institutions, such as *Purohits*, *Jotshis*, etc.

B.—(1) Land given to *chauth* holders.

(2) Land given to *inams*, etc.

(3) Land given to menials, etc., such as, *Dom*, *barbors*, etc.

C.—(1) Land given to *Kothriband Thakurs*.

(2) Land given to *Dhaus*.

(3) " " to *Chandhris* (relatives).

(4) " " to other *Sirdars*.

X (1). *Punarth* grants are generally the oldest, and were given by the Moghul Emperors, or the Jaipur Rajas, or the Mahrattas, or by the Bharatpur Chiefs for religious purposes to temples, Brahmins, and *Purohits*, etc. Those granted by former rulers before the Bharatpur State was founded were, as a rule, maintained by the Bharatpur Rajas where supported by a deed of grant (*sanad* or *shukka*). The *Masfidars* do not generally now possess the original *sanads* granted to them showing the area, object and conditions of the grant. The present authority generally consists of *chhut chitthis* or orders for release, which are usually to the effect that the *masi* held from of old by the grantees shall be similarly enjoyed hereafter.

(2). The origin of grants in *inam* and *chauth* to secure the services of matchlock-men has been described in Chapter II, as well as the gradual reduction since the time of Jawahir Singh.

(3). The *jagir* grants usually date from the 18th or the beginning of last century, and were originally held on condition of furnishing horses for military service. This system was maintained till the time of Ranjit Singh, but in the reign of Maharaja Balwant Singh these *jagirs* were resumed partly under the pretext that the *jagir* horsemen raided and looted in adjoining territory as explained in Chapter II, and service was given instead in a regiment of horse raised at head-quarters. Owing to recent reductions in the troops, this service, which was hereditary, has now generally ceased, but cash pensions were given to the incumbents brought under reduction. Grants made to foster relations (*dhaus*) or other persons of importance and Court favourites are generally known as *masi kansa*, *i.e.*, grants for maintenance.

145. In past settlements no attempt was made to prepare correct records for *masi* estates and holdings. In the settlement of 1855—57 whole revenue-free estates were not even surveyed, but *masi* holdings in *khalsa* estates were dealt with, except as regards assessment, in the same way as *khalsa* lands; the names and shares of the *Masfidars* were shown, and it was often specified whether the grant was held from the State or the *Zamindars*. In the settlement of 1890-91 whole estates were surveyed, but no proper records were prepared for them. It appears that there was usually some hesitation about deciding whether the land belonged to the *Zamindars* or to the *Masfidars*, and the entries were therefore left blank. The record of petty *masis* in *khalsa* estates was also incomplete and unreliable, and the grants from the State and the *Zamindars* were often confounded. In fact no regular *masi* enquiry was ever held, though the deaths of *Masfidars* were generally

reported by the Patwaris, and orders for mutation to the heirs or for resumption, as the case might be, were passed by the Darbar.

146. It was therefore decided that all grants should now be fully investigated during the settlement, and a special circular, No. 11 of 1898, laying down the principles to be followed in the enquiry was issued in 1898. The following are some of the chief provisions of that circular and the subsequent instructions:—

(1) "*Authority*.—The proper authority for a Mafidar to hold his *masi* land will be the *shukka* granted to him by any of the Maharnjas or by any other authority who was managing the State at the time of giving the *shukka*, and which *shukka* was subsequently recognised by the ruling Chief; also those *shukkas* which were granted by previous Emperors and other high personages, which were subsequently recognized by the Maharajas. If any Mafidar possesses no *shukka*, undisturbed possession since the settlement of *Sambat* 1912 will be considered as proper authority for his holding the *masi*, if he otherwise satisfies the investigating officer that, although he has got no *shukka*, he has been in possession of the land as original Mafidar or his heir.

"*Explanation*.—The word *shukka* includes *chhut chitthis* or other *daftar* records."

(2). Each grant to be checked with the original *sanads* or *shukka*, or subsequent *chhut chitthi* or orders of release, and also with the entries in the records of previous settlements.

(3). A separate register or form to be prepared for each grant, in which all the information connected with the *masi* is summarised.

(4). An abstract of the original *sanad* and subsequent orders relating to the grant to be obtained from the State office records and incorporated with the file.

(5). The following points to be specially enquired into:—

(a) Whether the grant is only for life or hereditary; and if hereditary, is the present Mafidar entitled to hold as a descendant of the original grantee?

(b) If the *masi* is held jointly by several co-sharers, their shares and the area in possession of each to be enquired into and defined.

(c) Is the Mafidar in possession of an area exceeding that originally allotted, allowance being made for variations in the standard of measurement?

(d) If the grant is a conditional one, are the conditions fully observed?

If the area exceeded that in the original grant or subsequent order of release, or (where there were no such documents forthcoming) if it exceeded the area entered in the records of the first settlement, the excess was generally resumed unless the Mafidars could show good cause to the contrary; but if the difference was less than one *bigha* or than 5 per cent. of the area, it was not taken account of, being accounted for by difference in the methods of measurements. The settlement of the area thus resumed was in the first instance usually made with the Mafidar where he had held long possession and he was entered as owner. If he refused to be responsible for the revenue the settlement was made with the Zamindars of the estate, *thok*, *patti*, or holding from which the *masi* had been allotted. The resumption was made from uncultivated or *barani* land where such was available, and the orders of resumption fixed the *jama* to be paid according to the village rates.

147. Under the rule of the last two Maharajas resumption of hereditary grants of long standing was frequently ordered on the death of a Mafidar, especially where he left no direct male heir, and advantage was taken of the absence of Mafidars or of their failure to pay the cesses due to the State to effect resumption. Such action as explained in Chapter II caused widespread distrust and dissatisfaction, and finally in 1897 the *nath* rule (resumption for failure of direct heirs) was abolished and the following rule substituted:—

"*Succession*.—The principles of succession of Hindu or Mahomedan law will apply according to the parties concerned being Hindus or Mahomedans, to all kinds of *masi*, except A (1), with the restriction that only the male descendants of the original grantees will be recognised as heirs.

"Adoption will not be recognised unless the adopted son is one of the male descendants of the original grantee, and that the previous sanction of the State for such adoption has been obtained. No ascendant of the original grantee or his (ascendants') heir will be recognised as proper heir to the Mafidar either by succession or through adoption.

"If there is no male descendant of the original grantee or successor by adoption under this rule, the *mafi* will revert to the State.

"If any female members of the last Mafidar's family survive him they will be entitled to maintenance during their lifetime.

Progress in the enquiry up to date.

148. The annexed table shows by tahsils the number of cases enquired into and disposed of:—

Serial No.	Tahsils	Number of cases instituted.	Number of cases submitted for Settlement Commissioner's final orders.	Number of cases pending.	Number of cases in which final orders were passed by Settlement Commissioner, or sent with his opinion to Council.	Number of cases pending in Settlement Commissioner's Court.
1	Bharatpur	440	43	406	41	2
2	Wair	81	2	79	2	...
3	Akheypur	50	15	44	12	3
4	Orfain	22	11	11	11	...
5	Rupbas	26	17	9	17	...
6	Biyana	210	...	210	...	...
7	Dig	296	61	235	80	1
8	Karna	160	107	53	107	...
9	Nagar	226	185	41	185	...
10	Pahari	240	144	96	144	...
11	Kumber	199	...	199	...	...
	Total	1,358	605	1,353	599	6

This table shows that out of the 605 cases in which the enquiry has been completed, 599 have been disposed of by me, and only 6 are pending, which have been now transferred to the State Council. There are still 1,353 cases under enquiry in the tahsils or in the Deputy Collectors' offices. These should be completed within the next few months and submitted to the Council for final orders, which should be carefully given effect to in the annual papers.

149. In former settlements the assessment that would be due on *mafi* lands if they were *khalsa* was not worked out. Hence there was no basis on which to calculate the cesses due to the State, which are usually a percentage on the valuation, or for reference in case of dispute between the Mafidars and Zamindars as to the rent or revenue to be paid by the latter. The Mafidars were at liberty to give their lands to cultivators on written lease for a year or term of years or to settle it verbally. This led to great difficulties in cases where the Mafidars were not themselves owners of the land, and the owners frequently appealed to the State to protect them from ejectment or rack-renting by the Mafidars. For the above and other reasons it appeared advisable to work out the assessment of all revenue-free grants. The matter was a delicate one, and to explain how it was disposed of, I quote paras. 127 and 128 of my report on the central tahsils:—

127. I propose to fix a nominal assessment for all revenue-free lands at the same rates as *khalsa* lands. This will not only be convenient as showing the extent to which revenue has been alienated by the State, but will also be of practical utility, as the Patwar cess and local rate (on such grants and at such rate as the Darbar may decide to levy it) will be calculated on such assessment, and in case of resumption owing to failure of heirs, etc.,

this nominal assessment will be enforced. The next question is, to what extent, if any, the State should enforce the nominal assessment as between the Mafidars (including all grantees under that name) and the Zamindars cultivating the revenue-free lands. This point was discussed in paragraphs 42 and 43 of the introduction to last year's report, and in paragraph 9 of the Political Agent's and paragraph 15 of the Agent to the Governor-General's reviews thereof. The matter has been further discussed in the correspondence noted below.

First Assistant to the Agent to the Governor-General's letter No. 945-C., dated 27th January 1899, to Political Agent.

My letter No. 1-C., dated 12th February 1899.

Political Agent's letter No. 7819, dated 21st February 1899, to First Assistant to the Agent to the Governor-General.

Where, as sometimes happens, the proprietary rights in the revenue-free grant vest in the grantee and the cultivators are merely the tenants, no question arises, for the Mafidar, like any other owner, can make his own arrangements with the tenants, subject to the general revenue rules of the State.

The difficulty arises in cases where the cultivating Zamindars are owners of the land and the Mafidar (using the word in its widest sense) is only entitled to the *jama*, as frequently happens where the *masi* grant is of recent origin. In such cases the Mafidar is admittedly only entitled to realise revenue (locally expressed in the term Mafidar *sirf thej ka malik hai*); and the question is, should he have the power of fixing the revenue at his pleasure, or is it to be fixed by the agency of the State, as between the Mafidar and the owner of the land?

The past practice has been that maps and records have been prepared for all revenue-free estates, in the same way as for *khalsa* villages, but the amount of the assessment to be levied by the Mafidar has, except in special cases, been left over to be settled by the Mafidar and the owners. The system, as might be expected, has led to many disputes, and when the dispute came to a head, the State has, especially in the time of the late Maharaja, freely exercised the right to interfere and fix the revenue to which the Mafidar was entitled. It is obvious that when such disputes arise the power to settle them must vest in some tribunal, *viz.*, in the supreme authority in the State, or whomsoever it may depute for the purpose.

128. The proposals I put forward to meet the difficulty are:—

- (1) a nominal *jama* must in any case be fixed for the calculation of cesses;
- (2) where the owners and the Mafidar wish to continue the present system of settling the annual demand by private arrangement, no interference is necessary;
- (3) should (a) the owners, or (b) the Mafidar, now or at any future time, owing to disputes, appeal to have the demand fixed, then the nominal *jama* now fixed will be given effect to as between them for the term of settlement.

In doing this the State will not be outstepping its authority, departing from past practice, or infringing the rights of either party. At present the Zamindars in *masi* estates almost invariably pay a cash assessment, fixed generally year by year or for a term of years, and the accident of the revenue of their lands being assigned to Mafidars instead of being realised by the State should not deprive them of the right to have the amount of that revenue fixed for the same term and on the same lines as in *khalsa* estates. The system proposed is not only in the interests of the Zamindars, but of a great proportion of the Mafidars as well. Most of the non-resident Mafidars at present receive a much smaller *jaria* than the State would demand if the estate were *khalsa*, and are habitually defrauded by the Zamindars. In fact, several of them have recently come forward and petitioned to have the *jama* fixed for twenty years, as in *khalsa* villages.

Of course in fixing the *jama*, any special cesses or privileges which the Mafidar has hitherto enjoyed will be taken into consideration, and each case will be disposed of on its own merits.

The Political Agent and Council cordially accepted these proposals, and para. 5 of the Council's letter No. 1799, dated 14th August 1899, may be quoted here for future reference:—

"5. The Council also agree with the Settlement Commissioner about the assessment of revenue-free lands (paragraph 128 of the report). This should however be clearly mentioned that a Mafidar will have free enjoyment of the increased revenue of a *masi* which might be enhanced by the new assessment, and which might exceed the *jama* (den) for which the grant was made, and the State will have no right to it. Also if the Zamindars will not pay the assessed *jama*, they will be treated like Zamindars of *khalsa* land as regards realisation of revenue."

In the time of the late Maharaja, when it was found that the present value exceeded estimated value as entered in the deed of grant, the excess was often resumed by the State. This was a most iniquitous practice, as the

increased value was often due to the Mafidar having expended labour and capital in improving the land; hence in the extract above quoted the Council have made it clear that the grantee should benefit by any increase in assessment, just as he may have to bear the loss consequent on reduction of assessment.

150. In the present settlement, therefore, the assessment of all the revenue free grants has been worked out as in the case of *khalsa* lands. It will serve the following purposes:—

- (1) Local rate—which for revenue-free lands is usually 2 per cent.—and Patwar cess Rs. 3-2-0 per cent. will be calculated on this assessment. *Inam* grants, it should be explained, do not pay local rate.
- (2) In case of resumption this nominal *jama* will be enforced.
- (3) This *jama* may be brought into working if either the Mafidar or the proprietor where the *mafi* and proprietary right are held by different persons, or both so desire.

Except in the case of *inam* or *chanth* grants and of petty *mafis* in which it is usually the land itself and not merely the revenue that has been allotted, the presumption in the case of other revenue-free grants—of whole estates or considerable shares in them—is that the grant does not affect the pre-existing rights of the Zamindars, and that the grantee is entitled merely to the land revenue. In my letters reporting the assessments I have mentioned all the villages in which the *zamindari* and *mafi* rights are held by different persons.

There are in all 49 whole villages and 43 shares in villages in which these conditions exist. Of these I have now, at the wish of one party or both, fixed the demand to be paid by the Zamindars to Mafidars in 38 whole villages and 40 shares of villages, so that there are only 11 whole villages and shares in three in which, at the wish of both parties, the old system will be maintained, and my nominal assessment will be used only for calculating the cesses. In these cases, however, should disputes arise hereafter as to the *jama* to be paid, that nominal assessment should be given effect to. I think all parties have now come to recognise that the fixing of a cash demand for twenty years as in *khalsa* villages is to their ultimate advantage. It has also been arranged that the Zamindars shall, as a rule, pay the cesses due to the State from the Mafidars, and shall in return be paid *hakk mukaddami* or *lambardari* dues by the latter.

Assessment of *chanth* lands in Dig.

151. The origin of the *chanth* system has already been explained. The area of *chanth* in Dig is —

Total area	...	...	...	...	58,929
Cultivated area	...	...	...	...	45,238
New demand	...	...	...	...	22,636

This area has been assessed at three-eighths of the *khalsa* rates. In case of resumption of area the *jama* will be enhanced by the remaining five-eighths, i.e., in the ratio of 5 to 3; e.g., a holding which has now been assessed at Rs. 30 will in case of resumption have to pay Rs. 80, but of course the liability for service will cease. Following the old practice *chanth* lands pay local rate on the actual demand, but Patwar cess on what would be the demand if the land were *khalsa*.

152. In some estates the Lambardars and other influential Zamindars receive small cash grants from the State known as *nankar*. The origin of the system cannot be ascertained with certainty, but the probable object of these allowances seems to have been to utilise the services of the leading men in promoting cultivation, assisting in collecting the land revenue, and generally aiding in the revenue administration. The *nankar* now allowed is of two kinds.

(1) The *nankar* allowed to five influential Meos in Pahari and Nagar is called *chaudhrayat*. These Meos receive from Rs. 100 to Rs. 200 a year. The original intentions have now been lost sight of, and the State gets no return for this expenditure. It is now proposed that these Chaudhris should be utilized as *Zaildars* are in the Panjab.

As to the remaining *nankar* in some villages only the Lambardars receive it; in others it is shared by all the owners.

The number of estates and the total amount allotted at present in each tahsil is as follows :—

Serial No.	Tahsil.	CHAUDHRI'S NANKAR.		OTHER NANKAR.		TOTAL.	
		Number of villages.	Amount.	Number of villages.	Amount.	Number of villages.	Amount.
1	Pahari	4	700	4	386	8	1,086
2	Kama ... ..	...	...	...	...	...	...
3	Dig ... ..	...	...	6	100	6	100
4	Kumbar ... ..	...	...	14	651	14	651
5	Akheygarh ... ..	...	...	40	1,109	40	1,109
6	Nagar	1	200	2	100	3	300
7	Bharatpur ... ..	...	...	12	609	12	609
8	Rupbas ... ..	...	...	25	448	25	448
9	Biyana ... ..	...	...	25	796	25	796
10	Wair ... ..	...	...	37	976	37	976
	Total	5	900	177	5,256	182	6,156

I think this sum, which is now frittered away among several hundred persons, few of whom derive any substantial benefit from it, might be utilised to remunerate Chaudhris to be appointed in each tahsil, in the same way as Zaildars in the Punjab. I therefore propose that in future these payments to bodies of Lambardars or whole villages should cease, unless where there is a very special reason for retaining them, and that in their stead the State allow Rs. 2 per thousand of the *jama* in each tahsil (excluding Nagar and Pahari, where there are already well-paid Chaudhris) to remunerate Chaudhris, who will be appointed from among the most prominent Zamindars with due regard to tribe and local influence and whose duties will be similar to those of Zaildars in the Punjab.

Of course the success of the scheme depends on the right men being selected in the first instance. I have not had time to advise the Political Agent and Council in these selections, in making which regard should be had to (1) possession of old *nankar* grants, (2) representation of the leading tribes and of their chief sections, and (3) personal fitness.

Excluding the present *chaudhrayat* grant, which should be maintained but converted into *zaildari* grants, the present *nankar* comes to Rs. 5,256, which is much more than Rs. 2 per thousand on the new demand would come to. The proceeds of the latter in eight tahsils, excluding Nagar and Pahari, will be about Rs. 3,300. From the fund so formed *inams* averaging Rs. 100 per annum could be given to from two to four selected men in each tahsil according to its size. The gain to the administration,—revenue, police, etc.,—if good men are selected and the system properly worked, will be considerable. What is at present most needed in Bharatpur is to raise the status of the Zamindars, and promote the growth of the sturdy yeoman class, which is found so useful in the Punjab as an intermediary between the Government and the people. There is abundance of good material in the State, but the policy in the past has been to regard the Zamindar as a cow to be milched dry, or as a sponge to be squeezed, and no steps have ever been taken to raise their position. The result is that nothing is done by the agricultural body to assist the administration. The tahsil Chaprasi and the Patwari have to be requisitioned for the most ordinary duties, and the collection of the revenue is left almost entirely in their hands.

their lands by sinking wells, etc., without any interference on the part of the owners. But if they fail to pay the *jama* for a year, they will be liable to be ejected on the application of the owners. In such cases a notice will be served on them from the tahsil that if they do not pay the rent due within the fixed period their occupancy rights will lapse. The owners may also sue for enhancement of rent for reasons defined in the new Revenue Manual, but in no case are they authorised to eject such tenants or to realise from them more than the fixed rent without the sanction of the Revenue Courts.

As explained in Chapter V the *malikana* now fixed is usually 1 or 2 annas per rupee. This will not usually be enhanced for the term of settlement unless the holding has been improved by the action of the owner—*e.g.*, if the owner has constructed a well, or by some other cause outside the tenant's exertions. In such cases the rent can be raised to the revenue rate of the class of land *plus* 4 annas per rupee *malikana*, but when enhancement has once been decreed no further suit shall lie for at least 10 years.

(B) By the *kadim* tenants are meant the tenants who had they claimed would probably have acquired occupancy rights in virtue of their length of cultivation and paying at the same rates as owners, but who owing to the above reasons have failed to bring forward their claims. These are now however debarred from claiming the superior status should the owners sue to eject them.

(C) For tenants other than occupancy tenants, the number of years they have occupied the land, whether they hold under a written *patta* or verbal agreement, with the rent actually paid, have been shown in the *khassras* and *kataunis*; and in future this information will be brought up to date every year, so that in case of claims by tenants for occupancy rights or by owners for ejectment there may be a basis for decision.

158A. The following table shows the number of claims for occupancy rights disposed of in each tahsil by summary order or separate suit and details of the number of cases and area in which claims were successful or otherwise:—

Serial No.	Names of Tahsils.	Detail.	NUMBER OF CASES INSTITUTED, WITH THEIR AREA				APPEALS.		
			Instituted.	Number of cases unsuccessful.	Number of cases successful.	Area of unsucc. cases.	Instituted.	Disposed of.	
								Accepted.	Rejected.
1	Pahari	Summarily ...	3,346	202	3,144	27,468	7	1	6
		On separate files ...	86	78	8	103	...	...	...
		Total ...	3,432	280	3,152	27,571	..	..	..
2	Kams	Summarily ...	3,322	577	2,745	26,108	...	...	...
		On separate files ...	...	...	...	...	3	...	3
		Total ...	3,322	577	2,745	26,498	..	...	..
3	Dig	Summarily ...	1,804	844	1,050	9,545	...	...	...
		On separate files ...	...	...	...	...	2	1	1
		Total ...	1,804	844	1,050	9,545	...	..	..
4	Kumber	Summarily ...	1,001	454	637	3,247	...	...	...
		On separate files ...	...	...	...	...	...	...	...
		Total ...	1,001	454	637	3,247	..	..	..

Serial No.	Names of Tahsils.	Detail.	NUMBER OF CASES INSTITUTED, WITH THEIR AREA.				APPEALS.		
			Instituted.	Number of cases unsuccessful.	Number of cases successful.	Area of cases suc- cessful.	Instituted.	Disposed of.	
								Accepted.	Rejected.
5	Akheygarh	Summarily ...	370	117	253	3,985	...	...	...
		On separate files ...	...	...	...	...	...	...	...
		Total ...	370	117	253	3,985	...	...	...
6	Nagar	Summarily ...	3,330	363	2,967	27,781	...	...	...
		On separate files ...	82	81	1	19	...	...	...
		Total ...	3,412	444	2,968	27,800	...	...	...
7	Bharatpur	Summarily ...	999	203	796	5,109	...	...	...
		On separate files ...	12	10	2	264	...	...	...
		Total ...	1,011	213	798	5,372	...	...	...
8	Rupbas	Summarily ...	1,443	176	1,267	8,028	...	...	...
		On separate files ...	...	...	...	...	2	1	1
		Total ...	1,443	176	1,267	8,028	2	1	1
9	Biyana	Summarily ...	1,501	113	1,388	19,329	...	...	...
		On separate files ...	3	2	1	191	1	1	...
		Total ...	1,504	115	1,389	19,520	...	...	...
10	Weir	Summarily ...	796	162	634	4,533	...	...	...
		On separate files ...	2	...	2	19	...	...	...
		Total ...	798	162	636	4,552	...	...	...
	Total	Summarily ...	18,092	3,211	11,881	136,812	16	4	11
		On separate files ...	185	171	14	601	...	...	...
		Total ...	18,277	3,382	11,895	137,413	...	...	...

This shows that 8 per cent. of the total cultivated area is under the cultivation of occupancy tenants. The area so held is largest in the Mewat or northern tahsils of Pahari, Kama, Dig, and Nagar, and is not considerable in the central or southern tahsils except Biyana.

In the three northern or Mewat tahsils of Nagar, Pahari, and Kama the area held in occupancy tenure ranges from 11 to 20 per cent. of the total. Owing to the greater density and energy of the population, and also to the influence of British ideas and the competition of British tenants from Gurgaon, the demand for land is considerable and tenant-right has a recognised-market value. In the central and southern tahsils, on the other hand, the tenants, though encouraged to bring forward their claims to occupancy rights, have shown little disposition to do so. In fact, as was the case in the Punjab at the first regular settlements 45 years ago, the owners are often more willing to concede than the tenants to accept the occupancy or protected status. The movement among tenants in the northern tahsils, to which it spread from British territory, to have their undefined and customary status now defined, is in these tahsils confined to the villages along the east boundary adjoining Agra and Mattra, where land has a higher value. Elsewhere the cultivators have as yet only dimly appreciated the advantages of the occupancy status, while they still, with the memory of

past over-assessments fresh in their minds, shrink from undertaking the responsibility for the land revenue incident to it. Hence the number of claims for occupancy rights in these tahsils has been comparatively few, and the area in which occupancy rights have been allotted is comparatively small. Other reasons for this indifference are—(1) many of the old tenants who, if they had kept a grip of their holdings, would now be entitled to occupancy rights, broke down or disappeared in the famine year; (2) those tenants who remained or who returned owing to the harshness of the revenue system preferred to cultivate from year to year, being afraid to obtain any permanent rights with the corresponding liabilities in the land; (3) in estates held in shares, the owners—especially in Akheygarh—give written leases to the tenants and alter the rent from year to year; (4) the orders passed by the State soon after the famine that the owners should not realise from the tenants more than they paid to the State, though not regularly enforced, gave the tenants a protection against enhancement; (5) a large proportion of the tenants still pay at owner's rates.

I am inclined to think that now that the new assessments have been given out, the relative position of owner and tenant defined, and the right of the former to exact from a non-protected tenant a rent in excess of the State demand clearly recognized, many tenants who have hitherto held back will bring forward their claims to occupancy rights. In fact, I have had numerous cases in which tenants who at the beginning of the operations distinctly disclaimed any such right have subsequently come forward to assert it.

159. Rules for the assessment of areas subject to alluvion or diluvion and to submersion have been framed and incorporated in the Revenue Manual. The area along the courses of the torrential streams—the Banganga and Gambhir—in the southern tahsils is chiefly affected. Hitherto there was no rule on the subject, and villages were paying the revenue of land which had long disappeared, while their neighbours were allowed to hold free of revenue new land formed. In this settlement the existing land under cultivation in the bed of the above streams, known as *khatli*, has been assessed. This land is generally *shamilat*. The cultivation of such land depends less on its quality than on the industry displayed in manuring and irrigating it from holes dug in the river bed. If it is temporarily left uncultivated no revision of the *jama* is necessary, but if the land becomes unculturable owing to deposits of sand, change in the course of the stream, etc., reduction of *jama* now fixed should of course be allowed. On the other hand, if new land fit for cultivation is formed in the bed of a river, it may be assessed at the rates fixed in the settlement for that class of soil. The rules now issued on the subject will apply to 134 villages of Wair (30), Rupbas (34), Akheygarh (6), and Biyana (64).

Old *lambardari* system. 160. The *lambardari* system, like all other branches of the revenue administration, has hitherto been vague and unsatisfactory.

In *masi*, *inam* and *chauth* estates *Lambardars* had never been appointed, and hence there was no proper machinery for the realisation of the State *jama* and other dues, and for the discharge of other executive duties.

The leading *Inamis* had to perform many public duties without any remuneration. In *khalsa* estates the *Lambardars* were allowed some remuneration from the State, known as *hakk mokoddami*, calculated at various rates on the *jama*. These rates varied not only from tahsil to tahsil, but from village to village; and though they ranged from Rs. 2-8-0 to 9 per cent. no reason for the variation could be found, except that the rates were usually highest in Jat and Gujar villages. The rates allowed were not given on the full demand, but after making deductions of 10 to 20 per cent. In fact the most perverted ingenuity had been shown in complicating a simple system. This *hakk mokoddami* originally represented the percentage of the profits which the State remitted in favour of the owners or their representatives. Hence in some cases the whole proprietary body still claims to share in it. As the present system of assessment usually leaves one-third of the profits to the owners, it has been held that they have no claim as owners to share in the *hakk mokoddami*, which is a percentage on the *jama* allowed to the *Lambardars* in return for their services in, and responsibility for, collecting the State demand and for the discharge of other obligations imposed on them by the State.

The number of Lambardars was generally much too high. In fact, in several estates all the owners divided the remuneration, and it was next to impossible to secure their attendance when required, and for the same reason the remuneration was often so low as to afford no real incentive to the proper discharge of their duties. No pains had been taken to select fit men or to define the responsibilities and improve the status of the position. Hence the Lambardars were often among the most impoverished of the co-sharers, and this was a temptation to their eking out a livelihood by illegal means—*e.g.*, misappropriating the *malba*, or defrauding co-sharers and cultivators in collusion with the Patwaris. Moreover, the *hakk mokaddami* allowed was often kept back for years under one pretext or another, and the Lambardars receiving no remuneration lost heart and made no attempt to promote cultivation or assist in the realisation of the State demand.

161. In 1898 the present administration tackled the subject on broad lines, swept away all complications and anomalies, and laid down—
 Reform of the lambardari system.

- (1) A uniform rate of Rs. 3-2-0 per cent., or 2 pice per rupee, for the whole State besides the Re. 1-9-0 per cent. from *malba*; but in the Ballabgarh *jagir* the old rate of 5 per cent. has been maintained.
- (2) This rate to be allowed on the revenue collected according as it is paid in.

Some subsidiary arrangements have still to be made for the smooth working of this latter rule, but the measures taken have not only considerably increased the remuneration of the Lambardars in these tahsils, but have also restored their confidence in the intentions of the State to deal fairly by them. As long however as the number of Lambardars continued as excessive and the average remuneration as low as at the beginning of the settlement, no great improvement in their efficiency could be expected. A regular enquiry into the *lambardari* system has now been undertaken village by village, one result of which has been to considerably reduce the numbers by getting rid of men who are self-appointed and have no just claim to the office. Efforts have been made to secure representation of each *patti* and caste, except in cases where the number of Lambardars was already excessive.

No standard has been fixed as to the average *jama* for which a Lambardar should be responsible, but we have aimed at an average approximating to Rs. 500, except where it is necessary to appoint Lambardars by *pattis* or according to castes, in which case the average runs as low as Rs. 200 or Rs. 300.

The reduction of Lambardars has been made only in cases where they were unfit owing to any of the following causes—minority, old age, poverty, misconduct, inefficiency, etc. Newly appointed or self-appointed men have come under reduction before those in whose families the office has long been hereditary. Where the existing Lambardars were not personally unfit owing to the above causes, the present number, even though excessive, has been maintained with the provision that no new appointment will be made on the death of any Lambardar till the required number is reached.

In *masi* and *chauth* villages also Lambardars have been or will be appointed as in *khalsa* villages. These will be selected from the men who are already carrying on the duties of Lambardars, though not formally appointed, or are otherwise fitted for the office. In *inam* and *chauth* villages *mujrai* at the usual rates will be paid from the Treasury out of the *chauth jama* or the *bhait*, or absence penalty paid in. In *masi* villages no cess is usually levied by the State except *dami*, and *mujrai* will be paid from the *malba*, but nearly all of these villages have now, as described in Chapter VII, been assessed for the term of settlement, and in doing so it has been arranged that the Zamindars shall pay the cesses due to the State, but shall receive *lambardari* dues from the *Mafidar*. Hence it only remains to appoint the Lambardars, and in this selection the *Mafidars* have been or will be consulted.

162. The following table shows the number of Lambardars, both present and former, and the average *jama* per Lambardar in each tahsil. This multiplied by Rs. 3-2-0 per cent. gives the average *hakk mokaddami* from the State, and by Rs. 1-9-0 per cent. the

remuneration from the *malba*. For the whole State the average *jama* per Lambardar is Rs. 400, and the average remuneration Rs. 18-12-0, *viz.* Rs. 12-8-0 from the State and Rs. 6-4-0 from the *malba*. In Dig, Kumber and Bharatpur the number of Lambardars is still excessive owing to the predominance of Jat estates in which it was difficult to carry out a reduction.

Statement of Lambardars.

Serial No.	Names of Tahsils.	Number of Lambardars.	Brought under reduction.	Nowly appointed.	Present number of Lambardars.	Number of Lambardars to be deducted owing to being counted more than once.	Correct number of Lambardars.	New <i>jama</i> .	Average per Lambardar.
1	Palari	612	103	3	612	74	439	2,31,100	523
2	Karna	473	169	1	355	46	309	1,63,050	523
3	Dig	797	209	36	637	29	609	1,56,692	303
4	Kumber	797	245	3	654	9	645	1,69,776	293
5	Akheygarh	612	291	89	697	4	693	2,20,752	367
6	Nagar	751	159	16	668	29	679	2,94,676	509
7	Bharatpur	644	179	83	553	2	551	1,75,990	319
8	Rupbas	627	345	67	649	2	647	2,49,967	457
9	Diyana	616	417	189	579	3	576	2,20,327	397
10	Wair	695	391	134	729	18	711	2,30,391	324
	Total	7,415	2,449	617	5,653	215	5,369	21,39,638	400

General remarks on the revenue machinery:

163. The existing machinery of the revenue administration has been referred to in Chapter III.

It consists of—

- (1) two Deputy Collectors on a present pay of Rs. 300 per mensem, each in charge of the five tahsils composing the Dig and Bharatpur *nizamats* respectively. One has his head-quarters at Dig, the other at Bharatpur. Their circles should be exchanged at intervals of two years. Both the present incumbents are capable men, and have a thorough knowledge of all branches of revenue and settlement work;

- (2) ten Tahsildars (paid from Rs. 80 to Rs. 120 per mensem),—one for each tahsil,—and 13 Naib-Tahsildars, the large tahsils of Nagar, Rupbas, and Wair having each 2 Naib-Tahsildars. The Tahsildars, with a few notable exceptions, are rather above the standard of Native States. They are well paid. Some have very good educational qualifications, and some have been trained in British territory, and I have utilised them as much as possible in the settlement. Great care should be taken to appoint only capable men with a knowledge of revenue work to vacancies that may occur. Till recently the tendency has been to appoint men related to the ruling family, or transfer men from other offices,—*e.g.*, the command of a State regiment, who have absolutely no qualification for the work. Once appointed it is difficult to get rid of them, as local and palace influence in their favour is powerful.

The same remarks apply with even greater force to the selection of Naib-Tahsildars from whom the Tahsildars should ordinarily be recruited. Recently, at the suggestion of the Darbar, I held an examination of the

(c) Naib-Tahsildars.

Naib-Tahsildars who had previously been put through a course of six months' training in settlement and revenue work. Of 13 who appeared, only 4 passed, 4 failed, but not so badly as not to be given another chance of qualifying, while the remaining 5 failed hopelessly—in fact showed the most astonishing ignorance of their every-day duties. The State has now dispensed with their services. Those of them who have special claims on the State will be provided for elsewhere, and the vacant posts have been given to qualified candidates. Three of the present Naib-Tahsildars are men who have been Sadar Munsarims in the settlement, and these should prove efficient men.

- (3) Kanungos and Patwaris. The action taken to improve this agency has been fully described in Chapter III. It is decidedly above the average of Native States as regards efficiency.

164. The State is therefore now in possession of all the machinery required to carry on the revenue administration efficiently and to secure the maintenance of the records up to date. Rules for Patwaris and Kanungos, as finally amended according to the experience gained in the last four years, have now been issued. A Revenue Manual explaining the system as now established, and embodying rules for the future guidance of Revenue Courts and offices, has been drafted, after a model furnished by me, by Munshi Mahmud Husain, and has been sent on to the Council for such addition and amendments as may be necessary before it is finally issued. It deals with the following subjects, to each of which a separate chapter is given:—

I.—Jurisdiction.

II.—Rights of the State and agriculturists, rules for the acquisition of land and payment of compensation.

III.—Transfers of proprietary or occupancy right by sale, mortgage, gift, etc.

IV.—Assessment and distribution of the land revenue.

V.—Cesses due from *khalsa*, *istamar* and *masi* lands.

VI.—Realisation of revenue, cesses, and arrears; coercive processes.

VII.—Transfer of holdings owing to desertion or arrears.

VIII.—Landlord and tenant.

IX.—Lambardars—their rights, duties, etc.

X.—*Malba*—rules as to its disposal.

XI.—*Masi* grants from the State or the Zamindars.

XII.—Di-alluvion rules and fluctuating assessment of *dahri* on other lands.

XIII.—Boundaries and deep-stream rule.

XIV.—Partition.

XV.—Miscellaneous.

XVI.—Procedure in Revenue Courts.

XVII.—Miscellaneous Revenue Departments.

The form of the annual records has also been defined, and the statements shown in the appendix have been framed so as to embody the necessary statistical information from year to year in a form corresponding as nearly as possible with that prescribed by the Government of India. There should, therefore, be no difficulty in supplying annual agricultural statistics, which will also be very useful to the State, as indicating agricultural progress or the reverse. The Political Agent and State Council will, I trust, see that the principles on which the present settlement has been carried out, are adhered to, at least in essentials, and that no alterations are made without good cause being shown. One most satisfactory result of the settlement has been to restore confidence to the people, and any action which might shake that confidence should be studiously avoided.

165. In Chapter III, I have referred to the excellent work done by Munshi Hira Singh, whose services were lent to me in September 1897 by the Punjab Government, and who now remains on as Revenue Deputy Collector. His colleague, Munshi Mahmud

Husain, has been Deputy Collector since 1894, and under me carried on the settlement work of four tahsils. He has shown both zeal and capacity, and is a very useful State official, but his judgment is now and again rather hasty. If the two Deputy Collectors work in harmony with one another, the revenue administration can be worked smoothly and efficiently; and I trust the Political Agent and Council will insist on this. Mr. Pyster has worked since January 1897, and I could not have had a more loyal or hardworking assistant. He now takes up a similar appointment in the Indore State.

166. The total expenditure has been Rs. 3,08,597-6-3 up to the close of the operations on 31st March, and this provides for a sum of Rs. 2,500 to meet the cost of printing this report and other miscellaneous items. The total income is Rs. 47,122-10-0, the chief item of which is Rs. 37,584 for mutation fees, part of which has still to be realised. Thus the net cost of the operations is in round numbers Rs. 2,61,000, or less than one-ninth of one year's demand on the area settled. In the Punjab and North-West Provinces the cost of a settlement is usually from one-half to one-third of one year's demand. I may claim, therefore, that the settlement has been carried out expeditiously and cheaply. The character of the work done can only be tested by experience, but I have no hesitation in saying that it is an immense improvement on the system, or rather the chaos, we were confronted with in starting the operations.

The cost of the settlement will be made good by the enhanced demand of three harvests. In Alwar the settlement of an equal area paying an equal *jama* has cost $1\frac{1}{2}$ lakhs more than in Bharatpur; the sole reason being that over a lakh of rupees and three years were wasted in an ineffectual attempt to carry out the work by a cheap but inefficient supervising agency. The Bharatpur State by adopting a proper system from the start has been saved that waste of time and money.

167. This report, I fear, runs to excessive length, and possibly some subjects may have been left unnoticed, while others may have been discussed with needless detail. For this my apology must be that, in trying to complete it before leaving the State, I have had no leisure to compress or revise it. The difficulty hitherto in Bharatpur has been that except for an antiquated Gazetteer compiled thirty years ago, there was absolutely no other authoritative account of the State and its administration. This blank I have attempted to fill up as regards the land-revenue administration, which is the most important of all. The settlement throughout has been much facilitated by the cordial support I received from the Political Agent, Lieut.-Col. Herbert, now Resident in Gwalior, and from the State Council. Of the latter, I am chiefly indebted to Rai Bahadur Munshi Sohan Lal, who, as an old Revenue and Settlement officer in the Punjab and Bikaner, was most anxious to help in improving the condition of the Zamindars and placing the revenue system on a sound basis.

If the settlement now completed contributes to both of these ends, I shall look back upon the time and the labour bestowed upon it as not spent in vain.

M. F. O'DWYER,
Settlement Commissioner, Alwar and Bharatpur.

ALWAR, 29th March 1901.

APPENDICES.

Aren Statement of

РЕЗУЛЬТАТЫ.

(6) In the first year the entry of columns 14 and 15 will be according to the settlement entry, which, after two years, in the second year, will be made in column 14 and 15, and in the third year, the entry of columns 20 and 21 will be made in columns 14 and 15, and so on.

[illegible]

No. 3.

Bharalpur State.

Crop Statement for Rabi of

Tahsil

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
PARTICULARS.	Food Crops.																		Non-food Crops.					REMARKS.
	Wheat.	Barley.	Gram.	Cojra (barley and wheat).	Bojar (barley and gram).	Gochul (wheat and gram).	Garden crops.	Zira, Dhania and other spices.	Vegetables and other food crops.	Total food crops.	Custor-seeds.	Taramira.	Oil-seeds (Sesban).	Tobacco.	Poppy.	Other non-food crops.	Total non-food crops.	Total food and non-food crops.	Total cropped area of both harvests.	Less area of double and treble crops.	Actual area under crops.	Fallow up to 3 years.	Total of area of columns 23 and 24.	
Chabi of all kinds
Dahri and Nabri
Barni
Total

NOTE.—Khates in black and Khadi in red ink.
The area of State property exempted from assessment to be included in Khata area.

BEYAKS.

owing to the distribution and collection of Treceni being in progress the Treceni entries cannot be made up to 15th August; it would be the duty of the Kennels to make these entries carefully with the help of the Molnár Jai, and the latter would be responsible for the correctness of the figures.

Statement showing yearly totals of mutations of proprietary rights and the rights of occupancy tenants of Tahsil

Bharatpur State.

Statement showing yearly totals of mutations of 1912																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
1	2	3	4	5	6	7	8	MUTATIONS BY SALES AND MORTGAGES OR POSSESSION BY MEANS OF GIFT.																REDEMPTION OF MORTGAGE.				29	30	31	32																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Sambal and year.	Details of rights transferred.	MUTATIONS OF PARTITION.						Number of mutations by succession.	MUTATIONS BY ORDER OF THE COURT.																BY PRIVATE ARRANGEMENT.				Number of mutations.	Total area.	Cultivated area.	Redemption-money.	Other mutations not detailed in this Statement.	State dues.	Talwani's dues.	Amount of fees levied on sanctioned mutations of sales and mortgages.	RS.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
		PROPRIETARY HOLDINGS.			AREA PARTITIONED.				Mortgage.				Gift.				Sale.				Mortgage.				Gift.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
		Former.	Present.	Total area.	Cultivated area.	Luna or rent.	Number of mutations.		Area transferred.	Amount of decree.	Number of mutations.	Area transferred.	Amount of decree.	Number of mutations.	Area transferred.	Price.	Number of mutations.	Area transferred.	Mortgage-money.	Number of mutations.	Area transferred.	Number of mutations.	Area transferred.	Number of mutations.	Area transferred.	Number of mutations.	Area transferred.	Mortgage-money.										Cultivated area.	AREA TRANSFERRED.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													

Note.—(1) Separate entries will be made for proprietary and occupancy holdings in column 2.

(2) Loans in case of proprietary holdings and rent in that of occupancy holdings will be shown.

(3) Mutations not attested in Mutation Register or not decided in separate files will not be taken into account here.

(4) The column "By order of the Court" does not cover the mutations caused by confiscation of the property of an accused in criminal offences, or those by order of the Revenue Court—the property of a defaulter being transferred to another person permanently or for a certain period, or those by order of the Civil Court, the property of a debtor being attached temporarily. Other temporary mutations will be shown with redemptions and permanent ones with sales.

Serial No.	Names of Tahsil from which the villages transferred.	Names of Tahsil to which the villages transferred.	Names of villages.	Number of villages.
1	Pahari	Kama	Jurabri.	1
2	Dig	Kama	Murar, Ghata, and Barauli Dhan.	3
3	Dig	Akheygarh	Ainchera.	1
4	Kumber	Akheygarh	Ronija, Kailari, Badhira, and Usir.	4
5	Kumber	Bharatpur	Gadhi Zalim Singh.	1
6	Bharatpur	Kumber	Sogar, Adbar, Nagla Jiwna, and Ghana Bhandor.	4
7	Akheygarh	Wair	Sawantpurah, Alipur, Nagla Bhavla, Naraoli, Nowalpur, Maharajpur, Mohammadpur, Khohra, Jaspur, Bhabikar, Arazi Bhabikar, Jharauti Pathaina, and Khadrans.	14
8	Wair	Akheygarh	Parawara, Borkhao, Hantra, Arodah, Jharhki, Pipli, Notha, Nurpur, Barha, Utardah, and Kharrampur.	11

On reduction of the Oochain tahsil its villages were transferred to the Akheygarh and Rupbas tahsils as shown below :—

(A) 27 villages transferred to the Akheygarh tahsil:—Karni, Banowan, Lolhara, Bajehra, Basia Kalan, Kuthin Kalan, Kuthin Khurd, Gagwana, Chainpura, Bachhaodi, Pingora, Gobra, Honta, Jahangirpur, Atari, Alipur, Thula, Lakhampur Jat, Basia Ubhey, Mai, Nagla Mai, Dabaoli, Shahpur, Paharsar, Bahlot, Dabra, and Nagla Bhua.

(B) 69 villages transferred to the Rupbas tahsil:—Mamtauli, Shahna, Baseri, Andhiari, Bahera, Kewasi, Nekpur, Rabimpur, Seri Kalan, Seri Khurd, Nagla Bija, Nagla Trian Mafi, Nagla Trian Khalsa, Pannai, Nagla Kalian Kundher, Hadauli, Madhera, Nagla Tikaita, Patti Tihya, Kasha Oochain, Patti Jungla, Patti Gilgila, Patti Para, Bharkoli, Karaira, Tabra, Jaicholi, Fatehpur, Bhont Kharka, Rund Kharka, Gahlao, Charari, Gujar, Pichuna, Nagla Bhagwantpura, Sonoti, Kurka, Sheopura, Bosoli, Kanjoli, Khatipur, Kakrana, Mandapura, Sri Nagar, Mandauli, Nibhera, Katehra, Rudawal, Jaraila, Bhawanpura, Dumaria, Karanpura, Charari Dang, Morsuli, Sirround, Lakhampur Lodha, Ranpur, Gujar Balai, Saimra, Sabalpur, Ratawa, Kharsa, Nagla Rohi, Bhainsena, Madariapura, Mahraoli, Sikroda and Bara.

On reduction of the Gopalgarh tahsil its villages were transferred to the Pahari and Nagar tahsils as shown below :—

(A) 47 villages transferred to the Pahari tahsil:—Tilakpuri, Amroka, Unchki, Jatauli, Matoki, Badha, Nagla Aram Singh, Iklehra, Sohampur Patti, Kaliana, Ghagwari, Ranp, Bhawapur Khori, Abhaipur, Raibka, Danishpur, Chandoopura, Maliki, Bhadaka, Gopalgarh, Joat Kadar, Joat Gawanti, Joat Sadruddin, Andhwari, Joat Daria, Joat Rahallah, Joat Paproh, Paproh, Dabrah, Joat Pahari, Joatri Pipal, Piruka, Bhojpur, Khanpur, Ardunka, Kankarka, Bakhshuka, Pali, Ladamka, Madhogarh, Mukatpur, Kheria Nau Abad, Piproli, Pipal Khera, Shah Doongar, Kaithwara, and Dundri.

(B) 90 villages transferred to the Nagar tahsil:—Patka, Dabhaoli, Padalwas, Banaini Chanda, Banaini Dhonkha, Banaini Khwaja Ratna, Banaini Garhi, Banaini Toda, Dwarkapur Seti, Gorkeen, Gobindpur, Alam Shahka, Baghoka, Barkhera, Sirthila, Berrha, Dawrala, Bhuraka Jatmal, Ram Singhpur Palki, Khesti, Domraki, Alghani, Gulmani, Jaisra, Jaisri, Raniala, Athi, Chhapar, Tajpur, Hasaipur, Jhanjar, Wazir Kheri, Udeypur Nihaon, Laban, Sohanka, Jalalpur, Laharwarah, Bhanakpuri, Hayatpur, Khohri, Manapuri, Lodhpuri, Nagla Bhuria, Dhanota, Akbarpur, Teeski, Rustampur, Thikri, Danialpur Kheraka, Khera Chhajja, Mahraipur, Shahawli, Bodli, Ghampurki, Harrajki, Jhantli, Sohampur Patti, Saidwara Patti, Kutahpur Patti, Sikari Patti, Kanailpur Patti, Bela, Rampur Posti, Kharkhari Teli, Dabak, Golki, Sri Rampur Doongri, Bonai, Imlari, Baldeobas, Balka, Bas Sabit, Behari, Raipur Sukhanti, Nagla Bhongra, Lurhka, Kakrala, Jagir Gulparha, Gulparha, Biehleri Beg Pahalri, Bhoapur Garhi, Nagal, Rasalpur, Rupbas, Jatbas, Orhki Mohamda, Orhki Dalla, Orhki Nirbhai and Kolari.

Serial No.	Names of Tahsils.	Detail.	Total area.	STATE JUNGLE.		UNCULTURABLE.		Culturable.	Now fallow.
				Rund.	Others.	Hills.	Others.		
1	Pahari	Khalsa... ..	236,254	278	1,647	10,316	29,200	15,701	2,034
		Mafi	3,412	...	...	...	21	68	57
2	Kama	Khalsa	201,017	524	354	20,133	16,705	13,916	9,760
		Mafi	18,671	...	48	1,763	1,172	625	816
3	Dig	Khalsa	187,591	4,011	3,005	12,863	11,255	36,727	15,361
		Chauth	58,866	...	50	606	2,826	7,182	5,073
		Istamrar	14,823	...	...	7	501	2,342	1,012
		Mafi	53,393	...	...	...	1,821	5,433	5,619
4	Kumher... ..	Khalsa	239,056	16,889	3,202	144	12,712	46,002	21,133
		Mafi	58,243	...	121	73	2,603	12,821	4,701
5	Akheygarh	Khalsa	218,926	427	280	...	13,179	23,461	19,496
		Mafi	27,442	13	75	...	1,291	1,192	1,297
6	Nagar... ..	Khalsa	284,005	918	1,254	12,808	18,286	30,041	20,572
		Mafi	8,733	...	89	...	377	787	748
7	Bharatpur	Khalsa	271,374	25,553	9,746	288	12,146	59,735	9,042
		Mafi	47,279	...	298	103	1,655	12,060	2,165
8	Rupbas	Khalsa	321,781	8,814	1,314	20,680	16,233	75,754	12,893
		Mafi	24,105	...	109	81	1,199	61	1,016
9	Biyana	Khalsa	470,390	290	2,376	147,619	87,905	59,423	15,573
		Mafi	30,088	...	20	2,480	2,790	3,141	1,095
10	Wair	Khalsa	349,988	1,367	3,884	47,205	31,689	46,876	18,050
		Istamrar	3,134	...	...	...	983	86	16
		Mafi	80,281	...	1,382	1,129	885	2,347	1,190
		Khalsa	2,811,288	58,101	27,062	277,956	247,400	407,639	145,244
Total	...	Chauth... ..	58,866	...	50	606	2,826	7,182	5,073
		Istamrar	17,937	...	...	7	1,487	2,428	1,028
		Mafi	802,337	13	2,092	5,629	13,761	44,637	18,734
	
GRAND TOTAL			3,190,418	58,114	29,204	284,198	265,477	401,886	170,070

Present.	Former.	Total.	Present.	Former.	Harshid.	Total.	Kharid.	Barani.			Total cultivated.
								Barani.	Har.	Total.	
6,718	6,503	17,221	21,155	48,573	10,303	83,267	...	69,351	5,110	74,500	171,058
151	15	20	591	1,167	53	2,111	...	919	6	925	3,256
6,553	16,165	22,778	3,313	19,214	11,091	23,297	...	75,615	8,966	84,611	140,595
1,272	2,071	3,443	223	2,705	1,289	4,316	...	5,415	1,013	6,458	14,217
12,717	9,225	21,937	1,179	3,622	11,071	17,835	...	59,161	5,419	64,600	104,372
6,219	3,623	10,172	659	821	1,196	2,706	...	29,216	1,036	20,251	43,129
2,250	1,291	3,641	...	...	...	...	...	7,201	113	7,314	10,858
5,529	6,439	11,269	137	1,235	786	2,158	...	26,715	319	27,061	40,490
25,023	10,150	41,173	4	419	2	425	...	91,415	1,561	96,276	140,874
7,671	3,577	11,551	2	13	...	15	...	25,915	413	26,358	37,024
49,212	9,771	59,163	8,416	855	2	9,293	...	129,056	3,628	132,694	192,680
6,277	691	7,061	1,519	...	...	1,519	4	11,068	251	14,919	23,574
16,247	5,672	21,059	46,259	16,101	4,639	67,317	...	93,838	12,852	111,720	200,695
635	291	597	2,226	311	73	2,613	...	2,761	428	3,192	6,732
26,191	11,631	40,225	16,656	4,169	4	22,679	...	89,355	3,376	91,760	151,891
4,737	3,677	8,411	1,550	525	...	2,375	...	19,959	258	20,217	31,039
21,659	16,859	38,599	29,913	33,536	673	69,622	439	71,593	11,659	86,492	186,104
3,258	1,129	4,117	1,559	4,910	56	6,555	32	3,875	437	4,312	15,636
39,063	10,561	49,651	17,174	4,353	1,451	22,928	656	67,491	16,235	83,636	155,991
6,290	1,767	8,017	2,418	1,469	7	3,831	48	8,290	1,063	9,263	21,162
52,223	17,748	69,971	12,551	2,131	275	14,999	618	93,215	22,051	115,266	200,969
674	31	705	...	...	...	...	5	1,327	9	1,336	2,019
7,450	2,543	9,993	2,429	273	19	2,721	20	9,715	949	10,691	23,399
215,917	125,731	371,681	162,992	120,753	39,978	332,523	1,761	850,149	91,478	911,618	1,617,956
6,219	3,953	10,172	659	821	1,196	2,706	...	29,215	1,036	30,251	43,129
2,924	1,428	4,352	...	...	...	...	5	8,523	122	8,659	13,097
43,674	21,607	65,291	13,095	12,584	2,412	23,091	124	118,235	5,227	123,462	217,468
293,761	152,722	451,456	176,353	144,161	43,596	364,130	1,893	1,096,118	97,563	1,103,951	1,921,430

Serial No.	Names of Tahsils.	Detail.	Kharif.									Total.
			Cotton.	Maize.	Jowar.	Masina.	Gawar Charri.	Til.	Dhan (Hoe).	Sugar-cane.	Others.	
1	Pahari ...	Khalsa ...	13,132	41,064	40,769	7,065	13,359	12,759	47	...	1,557	130,032
		Mafi ...	300	329	1,113	123	160	333	...	...	32	3,295
2	Kama ...	Khalsa ...	9,186	47,769	23,501	6,502	10,209	2,940	...	...	1,853	104,028
		Mafi ...	1,161	4,029	2,456	630	1,039	402	8	...	323	10,135
3	Dig ...	Khalsa ...	5,412	19,476	23,181	7,682	4,232	3,426	...	...	616	65,043
		Istamrar ...	235	1,591	2,952	1,366	466	238	...	...	56	6,952
		Chauth ...	1,965	5,815	11,429	4,803	2,115	1,344	...	...	163	27,667
		Mafi ...	1,564	3,639	12,963	3,693	1,543	1,656	...	...	206	25,265
4	Kumher ...	Khalsa ...	2,748	15,424	40,753	16,417	5,353	5,738	...	2	551	86,950
		Mafi ...	451	4,995	11,229	5,174	1,283	1,507	...	...	187	24,961
5	Akheygarh ...	Khalsa ...	7,371	49,378	40,041	34,933	6,199	7,509	...	...	2,147	149,590
		Mafi ...	399	6,039	3,743	4,816	1,195	644	...	...	396	1,732
6	Nagar ...	Khalsa ...	5,129	46,293	42,163	12,390	13,357	13,649	467	...	1,730	138,206
		Mafi ...	835	1,569	1,456	375	455	248	...	...	119	4,557
7	Bharatpur ...	Khalsa ...	2,029	19,527	37,339	16,374	4,562	3,657	3	19	1,631	66,091
		Mafi ...	457	4,276	9,506	3,722	1,048	995	6	...	433	23,447
8	Rupbas ...	Khalsa ...	8,223	76,199	13,705	14,149	9,169	18,024	1	210	5,565	145,248
		Mafi ...	760	6,531	995	1,326	933	1,227	...	6	201	11,949
9	Biyana ...	Khalsa ...	14,968	62,250	12,785	24,977	6,711	6,170	26	53	1,829	129,799
		Mafi ...	2,709	5,957	3,139	2,397	1,468	690	...	7	252	16,619
10	Wair ...	Khalsa ...	15,835	67,125	27,427	28,509	7,115	6,743	...	...	2,626	155,355
		Istamrar ...	225	600	236	272	109	45	...	...	36	1,582
		Mafi ...	2,638	6,231	3,693	2,550	647	727	3	...	230	16,371
		Khalsa ...	87,035	444,830	305,664	169,018	82,679	80,851	544	234	20,439	1,191,345
		Istamrar ...	480	2,237	3,188	1,638	675	303	...	...	92	8,533
Total ...		Chauth ...	1,965	5,815	11,459	4,803	2,115	1,344	...	...	163	27,667
		Mafi ...	10,154	43,510	50,293	24,814	10,093	8,431	17	13	2,451	149,595
Total ...		Total ...	99,637	495,502	379,956	200,278	95,462	90,020	561	297	23,144	1,377,411

Wheat.	Barley.	Gram.	Bejar.	Gochani.	Gajra.	Sarson, Tarn (Oil-seeds).	Tobacco.	Zira.	Others.	Total.	Total of both Crops.
7,497	11,769	28,619	12,316	209	1,270	8,531	335	29	1,193	77,150	207,202
167	223	637	242	154	19	169	12	...	47	1,667	3,962
5,119	9,667	27,243	8,319	1,956	63	3,979	136	31	244	67,063	171,093
555	1,262	3,245	1,010	179	22	536	19	...	54	6,632	17,029
4,173	5,450	25,917	2,417	169	149	2,211	464	162	352	45,241	111,256
575	1,581	1,527	1,711	...	16	255	32	...	32	4,121	11,071
2,607	4,144	8,539	441	145	45	852	167	36	35	16,690	44,357
2,135	3,252	8,338	1,135	52	199	1,017	23	32	149	16,399	41,669
10,239	13,429	25,659	92	24	99	6,533	239	143	322	56,853	143,975
2,971	4,078	4,551	16	5	109	1,175	82	15	296	13,538	33,499
9,511	20,927	13,257	873	315	1,035	1,577	950	1,355	1,207	51,073	209,656
1,743	3,555	1,133	119	82	151	155	102	125	297	7,527	21,759
5,766	14,799	34,434	7,377	7,535	1,245	7,057	700	54	1,305	84,573	222,731
633	731	717	413	266	76	332	18	5	76	3,318	5,902
16,763	12,623	23,009	6,949	5,549	2,945	4,541	166	107	1,474	73,865	159,966
2,666	2,050	4,560	1,146	...	231	910	17	...	295	11,574	32,021
10,232	15,659	11,022	9,575	2,297	3,465	7,819	515	2,674	1,106	67,667	212,915
1,427	2,237	391	452	61	392	691	35	195	95	5,930	17,555
10,714	17,161	8,677	4,377	375	2,359	2,230	172	5,979	1,835	53,909	163,709
1,953	2,409	1,243	591	53	121	180	...	572	426	7,953	24,574
6,040	20,476	16,453	3,057	1,135	1,293	521	863	6,440	2,974	61,265	216,643
152	237	91	8	...	...	1	5	20	20	542	2,125
1,313	3,191	2,360	507	227	40	84	65	543	319	8,669	23,040
91,959	148,314	223,378	55,450	26,269	12,962	45,851	4,510	16,974	12,024	638,697	1830,040
727	1,518	1,517	111	...	16	258	37	20	61	4,653	13,195
2,007	4,144	8,539	444	145	48	552	107	36	29	16,690	44,357
14,245	23,162	27,923	5,632	1,079	1,390	5,191	353	1,790	1,967	83,465	233,333
109,541	177,439	261,757	61,643	27,493	15,416	52,180	5,037	18,924	14,090	743,515	2,129,926

Serial No.	Names of Tahsils.	Details.	Total area.	Every sort of unculturable.	Fallow.		Total cultivated.	Chahi.			
					Old.	New.		Permanent Hal.	Permanent Sabli.	Temporary.	Total.
1	Pahari ...	Khalsa ... Mafi ...	236,057 3,118	40,107 27	17,021 07	2,027 13	169,000 8,306	7,408 28	923 7	4,040 8	12,477 118
		Total ...	239,175	40,511	17,001	2,040	173,215	7,560	100	4,048	12,500
2	Kama ...	Khalsa ... Mafi ...	202,012 10,778	37,031 2,008	15,851 681	2,453 218	147,507 12,000	10,670 1,814	0,482 605	773 230	17,025 15,216
		Total ...	210,720	39,038	16,531	2,712	160,506	12,554	7,177	800	20,540
3	Dig ...	Khalsa ... Chauth ... Istamar ... Mafi ...	186,757 58,020 15,600 53,075	35,500 8,500 1,340 1,821	37,501 8,354 2,590 7,319	5,631 1,521 109 1,114	107,428 42,000 31,111 43,116	14,000 5,201 2,641 7,117	4,047 2,620 631 3,172	658 312 312 835	20,318 11,163 3,537 11,322
		Total ...	314,061	42,021	55,469	8,671	207,200	32,525	11,036	2,121	46,542
4	Kumher ...	Khalsa ... Mafi ...	230,210 59,501	32,015 2,552	60,675 17,613	12,078 3,076	133,577 31,914	25,142 6,200	15,331 2,918	773 15	41,246 10,020
		Total ...	297,751	34,567	78,312	15,751	165,701	32,005	18,270	901	51,275
5	Akheygarh ...	Khalsa ... Mafi ...	218,847 27,421	13,937 1,308	31,810 2,200	22,200 1,011	180,000 21,015	36,344 6,553	0,485 1,023	430 61	45,200 6,521
		Total ...	276,271	15,305	34,010	21,111	202,815	41,038	10,506	497	72,810
6	Nagar ...	Khalsa ... Mafi ...	281,061 8,772	33,320 473	31,013 918	4,411 51	212,317 7,300	15,000 602	907 74	3,782 202	20,608 678
		Total ...	292,833	33,793	31,931	4,432	219,617	16,511	981	3,982	21,470
7	Bharatpur ...	Khalsa ... Mafi ...	271,374 47,270	27,827 2,258	107,544 13,406	11,008 2,631	121,025 23,051	23,011 1,700	15,307 3,875	753 171	32,101 6,416
		Total ...	318,653	30,115	120,960	14,002	162,076	27,840	10,212	924	48,606
8	Rupbas ...	Khalsa ... Mafi ...	321,784 24,105	45,040 1,364	99,107 7,447	9,435 411	167,503 14,973	15,015 2,017	9,027 1,032	1,080 51	26,631 3,117
		Total ...	345,970	47,013	106,641	9,846	182,170	17,026	10,070	1,743	29,744
9	Biyana ...	Khalsa ... Mafi ...	470,419 30,703	211,785 5,384	75,146 4,601	11,525 1,109	141,963 10,000	35,215 6,970	7,506 1,170	643 75	43,706 7,218
		Total ...	501,122	217,169	79,747	12,634	161,672	41,216	8,765	938	60,921
10	Wair ...	Khalsa ... Istamar ... Mafi ...	337,513 3,134 22,462	86,127 970 1,927	59,520 127 2,381	21,138 59 1,900	187,749 1,940 16,218	49,391 600 4,251	15,540 55 1,588	767 9 41	61,738 670 5,882
		Total ...	383,139	89,003	62,037	20,103	205,960	53,248	17,223	817	71,254
		Khalsa ... Chauth ... Istamar ... Mafi ...	2,810,033 59,020 18,734 293,300	600,087 3,600 2,368 20,416	538,097 8,358 3,025 50,085	106,979 1,824 253 3,323	1,573,270 45,238 18,083 20,673	232,172 8,221 3,190 39,175	80,587 2,020 700 15,801	14,580 318 321 1,009	333,336 11,163 4,217 56,645
		Total ...	2,180,902	620,870	600,765	121,591	1,835,164	282,758	105,723	16,888	405,369

Chahi Sairala.			Chahi Nahri.	Nahri.			Sairaba.					Barani.			Area cropped in the year.
Hal.	Sabik.	Total.		Hal.	Sabik.	Total.	Hal.	Sabik.	Barishi.	Khatili.	Total.	Barani.	Bhur.	Total.	
...	20,677 631	51,551 1,511	11,470 35	...	83,395 2,180	60,165 1,013	4,926 ...	74,034 1,013	176,420 2,342
...	20,677	53,392	11,608	...	85,678	70,121	4,926	75,037	...
...	132	24,456 3,001	13,358 1,000	...	37,945 4,003	80,504 5,176	11,222 1,055	91,726 6,201	159,895 13,657
...	132	27,460	14,417	...	42,009	65,290	12,307	97,997	...
...	6,131 1,452	12,680 1,200	...	18,811 2,751	61,149 30,000	6,022 1,319	68,071 31,322	112,768 38,031
...	1,513	761	...	2,304	7,438 29,425	129 304	7,567 29,792	11,620 44,193
...	9,126	14,740	...	23,866	128,017	8,734	136,752	...
...	361 8	...	...	361 8	90,121 24,350	2,146 627	92,267 24,877	136,699 34,866
...	372	...	...	372	14,471	2,673	117,144	...
...	5,611 13	...	...	...	5,611 13	124,407 14,957	3,735 281	125,235 15,205	169,169 27,275
...	5,657	...	...	...	5,657	139,484	4,019	143,503	...
...	43,671 2,092	18,953 325	4,705 111	...	67,365 2,531	111,853 3,482	12,501 460	124,354 3,501	233,300 8,328
...	45,760	19,311	4,810	...	69,896	115,335	12,910	128,245	...
...	14,595 1,720	4,016 802	...	...	18,011 2,522	62,242 17,312	3,711 272	65,933 17,584	126,252 29,393
...	16,515	4,818	...	...	21,433	79,554	3,983	83,537	...
...	22,634 2,992	25,846 3,014	730 56	471 61	59,691 6,723	63,063 3,814	11,042 445	74,105 4,259	181,985 16,239
...	25,026	29,469	780	532	60,404	66,877	11,487	78,364	...
2,595 332	...	2,595 322	505 216	454 239	399 61	840 303	12,164 1,667	3,216 918	1,707 259	559 39	17,769 2,973	61,269 7,582	15,279 1,058	76,548 8,640	169,348 21,829
2,930	...	2,930	751	693	450	1,143	13,831	4,134	2,047	627	20,639	68,851	16,337	85,188	...
1,830 449	...	1,830 416	...	...	...	...	9,167 1,422	491 21	418 19	...	10,096 1,462	91,127 7,418	19,952 1,012	111,179 8,469	199,353 17,206
2,270	...	2,282	...	...	...	...	10,589	503	437	20	11,545	99,815	21,033	120,848	...
2,226 1,652	...	2,232 1,652	505 216	454 239	386 61	840 303	138,387 10,507	135,314 11,779	45,161 2,294	1,009 20	319,952 21,679	814,933 114,562	91,469 5,485	906,402 120,045	1,674,315 211,047
3,878	...	3,884	761	693	450	1,143	148,891	148,575	48,751	1,170	347,402	905,206	98,490	1,006,615	1,955,513

Report I.—Some recent investigations into the nature of the infertile land in the neighbourhood of Bhadan, by Dr. J. W. Leathor, Imperial Agricultural Chemist—August 1912.

Introduction.

1. Some of the land in villages near Bhadan and irrigated from the Bhognipore branch, Lower Ganges canal, has been going out of cultivation during recent years; "usar" spots are said to have appeared or extended, and the defect is attributed to a serious rise of the sub-soil water level.

While there seems to be no doubt of this latter fact, the cause or causes of such rise are hardly matters that fall within my province. The disadvantage agriculturally of such a high sub-soil water level and the importance of reducing it are fully recognised. On the other hand it appeared to Mr. Burt and myself probable that an investigation of the nature of the soil in several respects might be of indirect value.

(i) One of the complaints is that the land is "water-logged," and estimations of the amount of water in the soils at different seasons would show in how far the amount of this constituent varies. In the soil for example excessively wet at the conclusion of the monsoon, and to what extent does it dry during the dry weather period, October to May?

(ii) Then the soil is said to have become "usar," and an examination of the nature of the salts, as well as their quantity, and the amount of variation during the year, become important factors.

(iii) Again the preliminary tests had shown that the soil, like so much of the usar of the United Provinces, is extremely impervious to water. Therefore the ascertainment of the rate at which water moves through these soils seemed to be of considerable importance. To this end a new method of testing this feature has been devised.

(iv) It also seemed worth while to make a number of pot-culture tests in order to try to ascertain what are the effects respectively of the alkali and of the imperfect physical condition of the soils on plants, the effect of certain manures, the plants which can grow in these soils best, and the feasibility of methods of reclamation.

(v) But apart from an examination of this affected land, an inspection of the surrounding villages which are not irrigated from the canal, showed that here also are patches of land which are apparently sterile and similar in appearance to those in the affected area. It is clearly of importance to examine some of the former in order to ascertain in how far they are similar to or different from the latter.

(vi) Several other questions have arisen in the course of the year. One is, in how far canal water can be held to be responsible for the creation of "usar?" Another, does the natural drainage water indicate that the alkali from the usar soil is passing away from it? A third, but only collateral one, is in how far have the experiments on the reclamation of usar at Aligarh affected the nature of that soil and the amount of salts in it? This investigation seemed to be important, because it might indicate possible useful methods for application at Bhadan. Much of the work is still in progress, especially the tests by pot-culture methods and the examination of the Aligarh usar, and these matters must remain to be dealt with subsequently.

The data obtained and the conclusions which may be at present drawn will be best understood if the former are set out as follows:—

(i) The amount of water in the soil at different periods.

(ii) The nature of the salts and their quantity speaking generally.

- (iii) The amount of vertical and lateral variation in the concentration of salts.
- (iv) The amount of seasonal variation in the concentration of salts.
- (v) The rate at which water moves through these and through other soils.
- (vi) The nature of sterile patches in non-canal irrigated villages.
- (vii) The nature of canal waters and their possible effect on soils.
- (viii) The nature of the drainage water.

2. Before entering into details of the data obtained, it is desirable to refer to the manner in which the specimens of soils were taken from the field for examination. This has been done in all cases by means of the cylindrical borer which was described in Memoir of the Department of Agriculture, no. 6, Chemical Series. It consists of an iron cylinder 2" diameter and usually 6" long, fixed to a shaft. It is pressed into the soil and when withdrawn again a small column of the soil, the same dimensions as the cylinder, is brought out with it. When taking specimens of soil and sub-soil, successive 6" columns are withdrawn from the same bore-hole throughout the desired depth. The tool is effective in dry and in moist soils; but if the soil is "water-logged," or contains an excess of water over what would drain away were it free to do so, the soil does not adhere to the cylinder and it slips away. The soils have been examined either to a depth of 9' in successive 6" portions or to the over-saturated soil if that were nearer the surface. This has necessitated the testing of a very large number of specimens from only a very limited number of places. If the question is asked would it not have been preferable to examine fewer specimens from each point, and so have been enabled to test the soil at a greater number of places, the answer is that in preliminary work of this nature it is preferable to test a small area thoroughly than the reverse. As will become evident, the thoroughness with which a few places have been tested in regard to certain characteristics, illustrates in what manner such investigations as the present may be curtailed in the future.

SECTION I.

The amount of water in the soil at different periods.

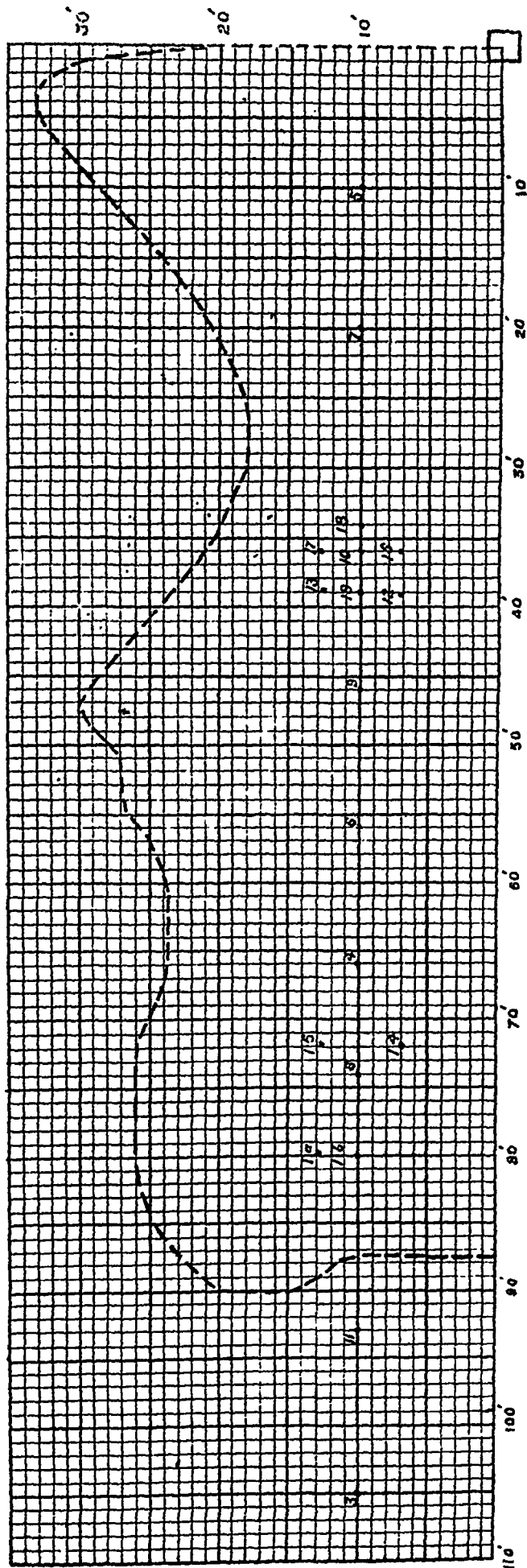
3. Several series of samples were taken by Mr. Burt in 1909 both from usar land as also from land bearing crops, and the moisture estimated in them. From these it was ascertained that the amount of moisture varied from about 5 per cent. or so in the first 6" of soil up to 20 odd per cent. at 5 or 6 feet from the surface and that over-saturation occurred frequently at 6 feet or 7 feet or less.

4. For the more accurate ascertainment of the moisture conditions in these soils at different depths and at different seasons, a bare usar patch was selected in each of two fields; near each patch "bench marks" were fixed; and from these the exact position of each boring was measured and registered. After taking a series of specimens from any point, the hole must necessarily be filled up again with other earth and no second boring may advisedly be taken from this particular point; but if its position can subsequently be ascertained, then a second set of specimens may be taken from a closely neighbouring point. Thus a series of tests may be made of specimens of soil lying approximately at the same place in the field. Without discussing here how near subsequent borings may advisedly be taken to one another, it may be mentioned that various considerations fix the minimum distance at about 2' 9".

The attached charts show the positions of the borings which have been made in the two usar patches in villages Surajpore and Galpura respectively.

5. At *Surajpore* after some preliminary work, a series of ten sets of specimens were taken between the 5th and 15th December each to a depth of 9 feet from the surface; these are represented by the numbers 2 to 11 on the chart. They were taken at approximately the same time and accordingly show in what degree the amount of moisture varies both vertically and laterally at the one time. Then secondly, in order to ascertain the degree of variation during the dry weather period, subsequent tests were made in the neighbourhood of two of the first borings; near no. 8 one test in duplicate was made on 4th and 5th February; near no. 10, three subsequent tests, also in duplicate, were made on (i) 3rd and 4th February, (ii) 1st and 2nd April, and (iii) 17th and 18th May.

SURAJPUR USAR PLOT *Plan showing position of borings.*



STATEMENT I.

Percentage of water in Surajpur Usar showing vertical and lateral variation.

Depth feet.	Number and date of boring taken in December 1909.									
	No. 3 6th.	No. 11 15th.	No. 8 12th.	No. 4 7th.	No. 6 9th.	No. 9 13th.	No. 10 15th.	No. 7 10th.	No. 5 8th.	No. 2 5th.
0—1	4.6	6.4	6.7	8.6	8.4	6.6	8.0	3.6	3.0	4.1
1—1	6.9	5.8	12.0	13.6	14.3	13.1	12.7	8.7	9.7	10.7
1—1½	11.2	8.3	16.6	17.3	16.6	16.1	13.6	15.0	12.6	14.1
1½—2	14.9	11.4	20.8	15.8	17.4	20.1	14.7	17.6	...	18.5
2—2½	17.3	12.7	..	19.3	19.7	20.6	16.2	20.6	18.6	19.5
2½—3	17.5	14.1	20.3	22.7	21.3	19.3	18.3	19.9	22.2	19.6
3—3½	18.4	16.8	21.8	22.8	22.4	21.4	18.5	21.0	21.1	20.3
3½—4	18.7	17.0	22.1	21.2	24.2	22.8	20.2	20.8	22.1	21.0
4—4½	19.1	18.4	22.3	24.9	23.9	22.5	22.0	23.4	23.5	22.2
4½—5	17.4	16.7	22.2	23.5	24.2	23.7	21.9	23.5	21.5	24.3
5—5½	17.8	20.5	20.8	26.1	24.8	21.7	21.5	21.6	21.4	23.4
5½—6	22.4	21.0	21.5	25.1	27.8	22.7	21.9	22.8	19.4	23.4
6—6½	24.3	22.8	24.2	26.9	24.5	23.4	20.6	21.4	19.5	27.3
6½—7	25.3	24.6	26.7	25.3	26.9	25.1	21.6	22.8	22.1	26.9
7—7½	27.7	25.6	27.1	25.5	25.3	25.1	20.2	22.8	22.7	25.0
7½—8	27.3	28.3	27.4	26.1	24.8	25.2	20.2	23.5	23.0	25.3
8—8½	29.2	28.8	28.2	26.6	29.0	25.1	20.7	25.4	25.3	27.1
8½—9	20.6	29.4	28.3	33.4	31.6	25.1	24.3	24.9	26.4	24.5

STATEMENT II.

Percentage of water in Surajpur Usar showing seasonal variation.

Depth feet.	Number and date of boring.						
	No. 10 15th Decem- ber 1909.	No. 12 3rd February 1910.	No. 13 4th February 1910.	No. 16 1st April 1910.	No. 17 2nd April 1910.	No. 18 17th May 1910.	No. 19 18th May 1910.
0—1	7.95	7.98	7.65	3.33	2.95	3.03	2.92
1—1	12.70	12.62	11.23	9.40	7.30	6.94	10.05
1—1½	13.64	14.61	13.97	12.23	10.64	12.19	14.27
1½—2	14.68	17.67	16.25	15.71	12.75	10.47	14.26
2—2½	16.19	18.83	15.35	16.62	13.03	11.53	17.54
2½—3	18.30	19.82	15.36	19.71	15.83	14.00	15.43
3—3½	18.45	18.05	14.16	16.39	17.15	15.02	19.15
3½—4	20.16	19.63	16.00	19.28	15.71	14.02	24.42
4—4½	22.00	20.60	22.00	22.15	18.96	17.50	22.07
4½—5	21.67	21.65	22.62	21.66	14.23	15.65	23.22
5—5½	21.51	21.22	19.49	21.05	19.31	15.55	21.64
5½—6	21.93	21.53	22.09	21.25	20.25	21.07	19.25
6—6½	20.56	20.75	20.12	20.02	21.26	20.69	21.26
6½—7	21.64	22.65	21.69	22.00	23.09	20.65	22.57
7—7½	20.15	22.23	22.49	21.65	22.52	21.07	22.57
7½—8	20.15	24.15	25.02	22.42	..	21.52	22.57
8—8½	21.55	21.63	25.17	..	..	..	..
8½—9	21.23	21.21	24.42	..	..	..	..

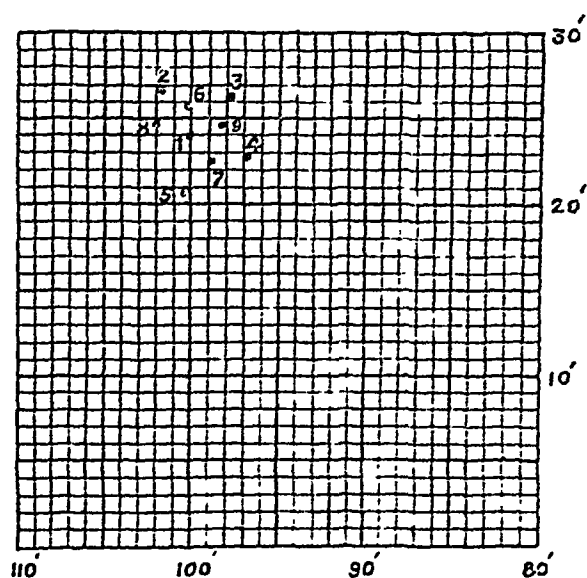
Depth feet.	Number and date of boring.			
	No. 8 12th, December 1909.	No. 14 4th February 1910.	No. 15 5th February 1910.	
0— $\frac{1}{2}$	6.69	8.14	8.66	
$\frac{1}{2}$ —1	11.98	13.54	12.30	
1— $1\frac{1}{2}$	16.55	16.33	15.17	
$1\frac{1}{2}$ —2	20.81	16.48	15.31	
2— $2\frac{1}{2}$..	19.14	18.86	
$2\frac{1}{2}$ —3	20.27	20.46	21.46	
3— $3\frac{1}{2}$	21.61	20.30	22.62	
$3\frac{1}{2}$ —4	22.07	24.41	24.62	
4— $4\frac{1}{2}$	22.29	24.13	24.66	
$4\frac{1}{2}$ —5	22.24	22.74	25.32	
5— $5\frac{1}{2}$	20.78	24.99	21.96	
$5\frac{1}{2}$ —6	21.54	25.11	25.93	
6— $6\frac{1}{2}$	24.23	23.76	26.74	
$6\frac{1}{2}$ —7	26.66	25.01	25.94	
7— $7\frac{1}{2}$	27.13	25.25	24.25	
$7\frac{1}{2}$ —8	27.36	27.11	23.83	
8— $8\frac{1}{2}$	23.21	27.05	23.23	
$8\frac{1}{2}$ —9	23.32	35.74	24.17	

STATEMENT IV.

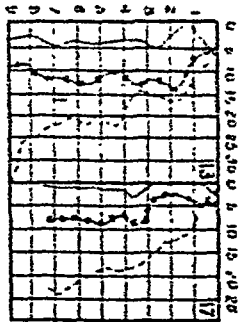
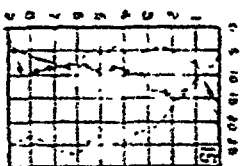
[illegible]

GALPURA USAR PLOT

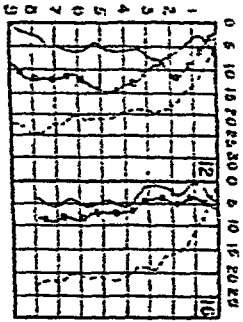
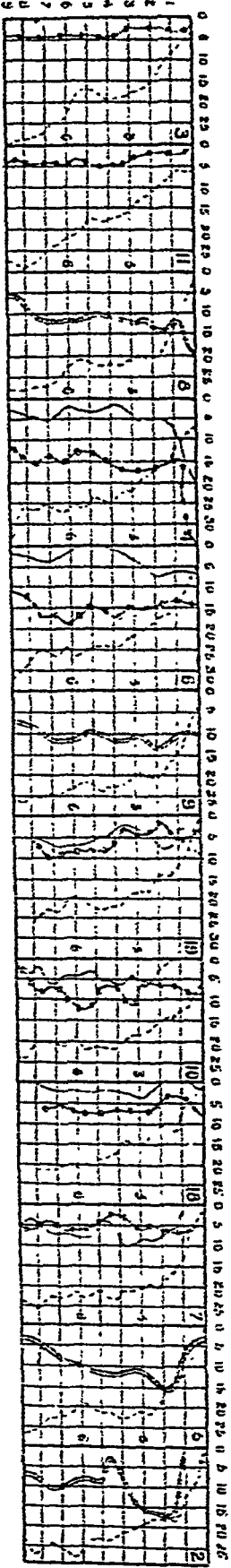
Plan showing the positions of the borings.



CHARTS ILLUSTRATING CONCENTRATION OF WATER AND ALKALI IN SURAJPUR USAR LAND.



ORDINATES : 1 UNIT = 1 FOOT
 ABSCISSAE : CONCENTRATION
 --- WATER PER CENT.
 ——— Na_2CO_3 PPM PER 10,000
 ——— NaHCO_3 " " "



--- WATER PER CENT.
 ——— TOTAL ALKALI as CARBONATE

6. The amounts of water found in these borings are set out in statements nos. I, II; III. Turning to no. I, the following will be observed to be the case in respect of the vertical variation; the amount of water in the first 6" varies somewhat erratically between 2 and 8 per cent.; in the second 6" and excluding borings no. 3 and 11, it rises to 9 up to 14 per cent.; subsequently there is greater uniformity and at 3 feet deep about 20 per cent. was present; from this depth down to 8 feet there is a more gradual increase, and at 9 feet it was generally quite wet. The two most westerly points, nos. 3 and 11, were taken where arhar plants were growing, i.e. in soil which was obviously better, and here the plant would naturally remove water not only from the surface but for some distance downwards, and accordingly there is less moisture at these points down to 5 feet than at other points in the plot.

Then secondly in respect of the horizontal variation, it is seen that differences of several per cent. frequently occur between two neighbouring points; thus comparing no. 10 with its neighbours nos. 9 and 7, which were 10 feet and 16 feet respectively away from it, the agreement is not very good in the first depth (6"); again in the second 6" no. 7 (east) contained 4 per cent. less than no. 10; in the third depth no. 10 contained 3 per cent. less than no. 9 (west) and 1 per cent. less than no. 7 (east), and indeed generally this soil contained throughout rather less moisture than its neighbours. The distances separating these three points namely 10 feet from no. 9 to no. 10, and 16 feet from no. 10 to no. 7, are however considerably greater than those which separated the subsequent tests from no. 10 and which were taken in order to ascertain the seasonal variations. Hence we may conclude that these subsequent "seasonal variation" tests would in all probability differ from no. 10 as also among themselves by say 1 per cent. or even 2 per cent. of moisture, due to the fact that the soil itself varies, and when making our subsequent estimate of desiccation and water lost, rise of water towards the surface, &c., this must be recollected, and differences less than 1 or 2 per cent. cannot be allowed much weight. Similar remarks apply to the tests which were subsequently made in comparison with boring no. 8.

7. Turning now to statement no. II the amounts of moisture in the soil in the neighbourhood of no. 10 throughout the dry season are set out, nos. 12 and 13 were taken on 3rd and 4th February, nos. 16 and 17 on 1st and 2nd April and nos. 18 and 19 on 17th and 18th May. An examination of these figures shows at once that there is no great decrease of moisture in the soil throughout the hot weather; the first 6" lost about 5 per cent.; the agreement among the corresponding tests in the second 6" was not very good, but the decrease was probably 4 or 5 per cent.; in the depth 1' 0"—1' 6" no. 17 was erratic, but one cannot well put the decrease higher than about 1 per cent., and below 3 feet the data indicate that there was no appreciable decrease at all. The soil was moreover supersaturated below 8 feet in May. I estimate the total decrease during the period December 15th to May 18th to be equal to about 7 lbs. of water per square foot, or approximately equivalent to 1.3" on the surface.

8. The test in the neighbourhood of no. 8 boring was not complete because nos. 14 and 15 (Statement no. III) were taken on the 4th and 5th February and there is nothing to show what the decrease was during the hotter months; but so far as the test went it supported the evidence obtained in the proximity of no. 10. These various moisture data are also shown on the photo. chart, which provides a very good comparison.

9. We may now turn to an examination of the similar data obtained in the usar patch at village Galpura. Here all the nine borings were taken, as the chart shows, around one central point and the amount of moisture present is set out in statement no. IV. The vertical and lateral variations are shown by the borings Nos. II—V taken between the 15th and 18th February where the same characteristics are present as in the Surajpur usar. This soil was also quite wet at 7 or 8 feet from the surface. Subsequent tests were made on (i) 30th and 31st March and (ii) on 15th and 16th May. These tests, like those at Surajpur, show no material decrease of water in the upper soil during the dry season.

10. But whilst these figures show the *concentration* of water in the soil and any drying effect of the season, they do not in themselves show how much water evaporated at the surface. On the basis of the arguments which I used in respect of this subject in Memoir no. 6 the very small decrease of concentration of water in the surface soil would indicate an equally small loss of water, that is I consider the decrease of percentage of water in these soils to be equivalent to the total loss; and that any decrease of water at say 9 feet must be due to drainage accompanied by a general lowering of the sub-soil water. However we have another indicator of the amount of water which rises to the surface during the dry weather, namely the salts. It must be allowed that if water is moving upwards through the soil towards the surface, these salts must accompany it and concentrate at the surface. As will be seen presently the amount of such concentration is just as small as the decrease of water concentration, and we have therefore additional evidence that in these soils the total amount of upward movement of water during dry weather is very small. Again in section v of this note evidence will be given of the very slow rate at which water moves through these soils and this naturally forms an additional support of the argument just used. On the other hand below 9 feet at Surajpur and below 7 feet at Galpura the soil becomes sandy and in this there was apparently little obstruction to the free movement of the soil water.

SECTION II.

The nature of the salts in the soil, and their quantity speaking generally.

11. The "alkali" in these soils consists almost exclusively of carbonate; the amount of chloride and sulphate was generally less than could be ascertained with ordinary means, and the amount of each is less than .005 per cent. The carbonate includes generally both the normal carbonate and the bicarbonate. In four of the earlier borings these were not separately determined, but the evidence regarding the relative proportions of these two salts is nevertheless sufficient for our purposes.

12. Regarding the method employed in the extraction of these salts, it will be sufficient to say that the soil was shaken intermittently for about 18 hours with five times its weight of water and the aqueous extract was then forced through a Houston's pressure filter. This filter consists simply of a Pasteur-Chamberland candle fixed in a pressure vessel. We were much disappointed at the rate at which this filtration could be effected; in most cases the quantity of extract required was not obtained in less than several hours. It was known beforehand that the filtration would probably be slow, but the process nevertheless occupied more time than was anticipated. An excessively fine slime collects on the candle and although thin, it reduces the rate of filtration enormously. Under the microscope this material is seen to consist for the most part of fairly well-defined particles, and the amount of actual colloidal matter present, and which is the cause of the obstruction to the passage of water both here as likewise in the field, is certainly only small when reckoned as a percentage, but it is uniformly distributed and hence acts among all particles alike. A number of experiments were made in which this colloid was coagulated; sodium chloride for example effects this coagulation perfectly; but the amount of alkali found in the filtrate differed from that in the simple aqueous extract, and it was hence decided that, protracted as the filtering operation must necessarily be, the results obtained would be more reliable if water were alone used than if a coagulator were employed. The result of this decision was however to both limit the amount of work done as also to necessitate a serious deferment of the actual analysis after the sample was taken. At first only one filter was obtainable; this was subsequently increased to two and later again to four and five. Closely as Mr. Kar applied himself to the work he could only deal with two specimens of soil per filter per day and this only by getting up each night to attend to them. With one filter then, a single set of specimens from one boring occupied nine days; with two filters half that time. I mention these particulars in order to show how impossible it was to carry out the original idea which had been to determine the alkali in the fresh specimens of soil on the same day as they were taken from the field. Far from this being the case

they had to be kept for weeks before they could in their turn be dealt with. The results are set out in statements V to VIII.

13. The following procedure was adopted. The specimen of soil was weighed in the boring tool and then transferred to good paper in which it was kept until analysed. In how far the normal carbonate became, by partial contact with the air, changed to bicarbonate it is not really possible to say. In several cases specimens of the same soil have been tested at intervals of several weeks; the specimens being in the interval wrapped in the brown paper, and in these no such change has been found to have taken place. Hence such evidence as we have goes to add weight to the value of the ascertained quantities. In any case the matter is not of very great importance at present, because there is collateral evidence that the data are approximately correct. All the quantities are stated as percentages on 100 parts of *dry* soil; those of the normal carbonate are entered in the statements in italic figures, whilst those of the bicarbonate are in roman figures. Where the two salts were not differentiated, the quantities are entered in roman figures and the alkali is styled, "total alkali."

14. The amount of the two carbonates is usually less than .2 per cent., but is generally more than .1 per cent.

The quantities are, for the Surajpur usar, set out graphically in the series of charts (p. 5.)

The carbonates have been assumed to be the sodium salt, but this point is to become the subject of a separate investigation.

STATEMENT V.

Percentage of *Sodium carbonate* and *Sodium bi-carbonate* in the *Surajpur Usar* showing vertical and lateral variations.

Depth feet.	Number and date of boring taken in December 1909.									
	No. 3, 6th.	No. 11, 15th.	No. 8, 12th.	No. 4, 7th.	No. 6, 9th.	No. 9, 13th.	No. 10, 15th.	No. 7, 10th.	No. 5, 8th.	No. 2, 5th.
0-1 .. {	<u>027</u>	<u>018</u>	<u>157</u>	<u>169</u> <u>819</u>	<u>059</u> <u>137</u>	<u>102</u>	<u>082</u>	<u>055</u>	<u>047</u>	<u>73</u>
1-1 .. {	<u>040</u>	<u>024</u>	<u>111</u>	<u>091</u> <u>136</u>	<u>058</u> <u>131</u>	<u>106</u>	<u>053</u>	<u>072</u>	<u>056</u>	<u>nil</u>
1-1½ .. {	<u>023</u>	<u>018</u>	<u>135</u>	<u>053</u> <u>169</u>	<u>066</u> <u>142</u>	<u>121</u>	<i>trace</i> <u>060</u>	<u>055</u> <u>059</u>	<u>147</u>	<u>105</u>
1½-2 .. {	<u>023</u>	<u>022</u>	<u>141</u>	<u>152</u>	<u>079</u> <u>188</u>	<u>140</u>	<i>trace</i> <u>053</u>	<u>051</u> <u>072</u>	<u>168</u>	<u>185</u>
2-2½ .. {	<u>025</u>	<u>025</u>	<u>114</u>	<u>053</u> <u>137</u>	<u>054</u> <u>151</u>	<u>134</u>	<u>049</u> <u>055</u>	<u>053</u> <u>059</u>	<u>144</u>	<u>170</u>
2½-3 .. {	<u>026</u>	<u>031</u>	<u>125</u>	<u>053</u> <u>172</u>	<u>053</u> <u>150</u>	<u>105</u>	<u>078</u> <u>059</u>	<u>079</u> <u>054</u>	<u>130</u>	<u>165</u>
3-3½ .. {	<u>029</u>	<u>043</u>	<u>116</u>	<u>027</u> <u>179</u>	<u>031</u> <u>152</u>	<u>119</u>	<u>047</u> <u>115</u>	<u>095</u> <u>059</u>	<u>112</u>	<u>152</u>
3½-4 .. {	<u>051</u>	<u>046</u>	<u>117</u>	<u>011</u> <u>160</u>	<u>011</u> <u>173</u>	<u>123</u>	<u>067</u> <u>053</u>	<u>102</u> <u>037</u>	<u>119</u>	<u>130</u>
4-4½ .. {	<u>044</u>	<u>051</u>	<u>104</u>	<u>145</u>	<i>trace</i> <u>154</u>	<u>110</u>	<u>057</u> <u>057</u>	<u>043</u> <u>016</u>	<u>131</u>	<u>069</u>
4½-5 .. {	<u>041</u>	<u>047</u>	<u>103</u>	<u>032</u> <u>132</u>	<u>146</u>	<u>106</u>	<u>053</u> <u>055</u>	<u>025</u> <u>023</u>	<u>124</u>	<u>021</u>
5-5½ .. {	<u>039</u>	<u>038</u>	<u>115</u>	<u>023</u> <u>109</u>	<u>152</u>	<u>100</u>	<u>021</u> <u>126</u>	<u>059</u> <u>050</u>	<u>126</u>	<u>053</u>
5½-6 .. {	<u>044</u>	<u>035</u>	<u>117</u>	<u>020</u> <u>135</u>	<i>trace</i> <u>176</u>	<u>125</u>	<u>056</u> <u>120</u>	<u>052</u> <u>059</u>	<u>113</u>	<u>051</u>
6-6½ .. {	<u>041</u>	<u>045</u>	<u>116</u>	<u>022</u> <u>150</u>	<u>021</u> <u>166</u>	<u>121</u>	<u>039</u> <u>110</u>	<u>051</u> <u>020</u>	<u>103</u>	<u>054</u>
6½-7 .. {	<u>044</u>	<u>037</u>	<u>126</u>	<u>057</u> <u>134</u>	<u>034</u> <u>153</u>	<u>123</u>	<u>093</u> <u>070</u>	<u>070</u> <u>035</u>	<u>093</u>	<u>053</u>
7-7½ .. {	<u>043</u>	<u>043</u>	<u>116</u>	<u>041</u> <u>157</u>	<u>034</u> <u>164</u>	<u>118</u>	<u>056</u> <u>056</u>	<u>076</u> <u>049</u>	<u>053</u>	<u>102</u>
7½-8 .. {	<u>049</u>	<u>049</u>	<u>097</u>	<u>045</u> <u>157</u>	<u>031</u> <u>180</u>	<u>091</u>	<u>025</u> <u>055</u>	<u>064</u> <u>041</u>	<u>032</u>	<u>114</u>
8-8½ .. {	<u>046</u>	<u>036</u>	<u>058</u>	<u>036</u> <u>134</u>	<u>025</u> <u>056</u>	<u>082</u>	<u>049</u> <u>051</u>	<u>031</u> <u>055</u>	<u>051</u>	<u>094</u>
8½-9 .. {	<u>043</u>	<u>041</u>	<u>058</u>	<u>072</u>	<u>020</u> <u>104</u>	<u>074</u>	<u>034</u> <u>031</u>	<u>050</u> <u>046</u>	<u>044</u>	<u>071</u>

N. B.—The carbonate is indicated by italic figures, the bi-carbonate by roman; where the total alkali was determined as carbonate as in nos. 8, 9, 5, 2, the quantities are stated in roman underlined with —.

STATEMENT VI.

Percentage of carbonate and bi-carbonate in Surajpur Usar showing seasonal variation.

Depth feet.	Number and date of boring.						
	10, 15th Decem- ber 1903.	12, 3rd February 1910.	13, 4th February 1910.	16, 1st April 1910.	17, 2nd April 1910.	18, 17th May 1910.	19, 18th May 1910.
0— $\frac{1}{2}$.. {	nil ·092	·049 ·092	·055 ·057	·033 ·030	·014 ·019	·010 ·067	·071 ·043
$\frac{1}{2}$ —1 .. {	nil ·033	·018 ·062	·026 ·037	·014 ·040	nil ·046	nil ·032	·027 ·066
1— $1\frac{1}{2}$.. {	traces ·060	·046 ·102	traces ·083	·008 ·032	nil ·029	nil ·032	·082 ·049
$1\frac{1}{2}$ —2 .. {	traces ·063	·069 ·123	·024 ·143	·033 ·064	nil ·023	nil ·026	·092 ·014
2— $2\frac{1}{2}$.. {	·019 ·055	·078 ·090	·048 ·135	·018 ·042	nil ·018	·014 ·057	·019 ·039
$2\frac{1}{2}$ —3 .. {	·078 ·039	·083 ·079	·056 ·120	·016 ·012	nil ·031	·037 ·070	·043 ·030
3— $3\frac{1}{2}$.. {	·047 ·116	·059 ·132	·043 ·138	·010 ·048	·016 ·093	·035 ·067	·030 ·033
$3\frac{1}{2}$ —4 .. {	·067 ·039	·050 ·130	·038 ·129	·059 ·071	·022 ·076	·027 ·070	·029 ·035
4— $4\frac{1}{2}$.. {	·057 ·057	·056 ·148	·042 ·102	·036 ·072	·014 ·035	·018 ·063	·019 ·083
$4\frac{1}{2}$ —5 .. {	·053 ·065	·059 ·147	·044 ·111	·049 ·071	·016 ·083	·016 ·072	·030 ·094
5— $5\frac{1}{2}$.. {	·024 ·126	·042 142	·042 ·123	·055 ·074	·014 ·083	·017 ·075	·072 ·092
$5\frac{1}{2}$ —6 .. {	·036 ·120	·046 ·132	·042 ·133	·055 ·085	·016 ·073	·022 ·075	·069 ·083
6— $6\frac{1}{2}$.. {	·039 ·110	·061 ·112	·014 ·123	·015 ·030	·015 ·073	·020 ·034	·071 ·053
$6\frac{1}{2}$ —7 .. {	·016 ·039	·055 ·121	·016 ·121	·051 ·084	·018 ·075	·022 ·057	·071 ·093
7— $7\frac{1}{2}$.. {	·056 ·036	·019 ·120	·011 ·121	·030 ·092	·016 ·075	·021 ·071	·067 ·093
$7\frac{1}{2}$ —8 .. {	·025 ·053	·031 ·123	·031 ·114	·079 ·053	..	·016 ·053	·051 ·059
8— $8\frac{1}{2}$.. {	·049 ·051	·025 ·125	·039 ·021	..	..	..	..
$8\frac{1}{2}$ —9 .. {	·036 ·034	·017 ·103	·036 ·037	..	..	..	..

STATEMENT VII.

Percentage of total alkali in Surajpur Usar showing seasonal variation.

Depth feet.	Number and date of boring:		
	8, 12th December 1909.	14, 4th February 1910.	15, 5th February 1910.
0— $\frac{1}{2}$	·157	·140	·243
$\frac{1}{2}$ —1	·111	·134	·145
1— $1\frac{1}{2}$	·136	·132	·143
$1\frac{1}{2}$ —2	·141	·144	·154
2— $2\frac{1}{2}$	·114	·114	·131
$2\frac{1}{2}$ —3	·126	·100	·126
3— $3\frac{1}{2}$	·116	·104	·097
$3\frac{1}{2}$ —4	·117	·110	·121
4— $4\frac{1}{2}$	·104	·095	·104
$4\frac{1}{2}$ —5	·103	·113	·118
5— $5\frac{1}{2}$	·115	·118	·093
$5\frac{1}{2}$ —6	·113	·113	·140
6— $6\frac{1}{2}$	·118	·147	·127
$6\frac{1}{2}$ —7	·126	·123	·127
7— $7\frac{1}{2}$	·116	·124	·113
$7\frac{1}{2}$ —8	·097	·122	·131
8— $8\frac{1}{2}$	·083	·077	·113
$8\frac{1}{2}$ —9	·058	·099	·067

STATEMENT VIII.

Percentage of carbonate and bi-carbonate in Galpura near showing vertical, lateral and seasonal variation.

[illegible]

SECTION III.

The amount of vertical and lateral variation in the concentration of alkali.

15. The percentage ("concentration") of carbonate and bi-carbonate, or total carbonate respectively, was determined in the same specimens as were employed for the moisture determinations, and the data are set out in statements nos. V. to VIII.

16. *Surajpur*.—The amount of variation in the vertical and in the lateral directions as well as variations in the relative amounts of the two carbonates in the Surajpur plot are set out in statement V.

Commencing with nos. 3 and 11 it is seen that this soil contained no normal carbonate. This land was outside the area of usar (vide chart). From here eastwards the proportion of normal carbonate increased until at boring no. 7 it was greater than the bi-carbonate. These variations are well brought out in the series of charts (p. 5.) Excepting the broad distinction just mentioned, there is no great regularity among the quantities of carbonates. They vary both laterally as also vertically within considerable limits, and there is no evidence that the upper soil or the lower soil contains even generally the greater part. There is an indication that there is less at 9 feet than above this point; but as there is here a bed of sand, or sandy soil, in a supersaturated state, no particular value can be placed on the deduction.

17. *Galpura usar*.—The corresponding data for the Galpura usar patch are set out in statement VIII. The four sets of specimens taken in February possess much the same features. They were taken much closer together than the ten "December" sets from the Surajpur plot, and one might consequently expect greater uniformity in the amount of alkali; this is the case, but the variations are nevertheless considerable. Here again there is no indication of any accumulation of alkali in a particular stratum. Indeed throughout the work on these soils no indication whatever of a "saline sub-stratum" has been met with.

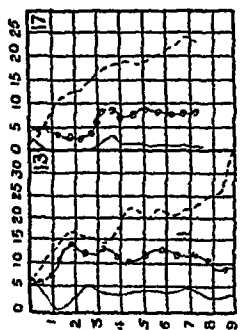
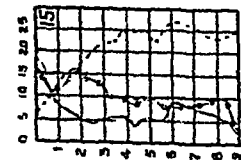
SECTION IV.

The amount of seasonal variation in the concentration of the salts.

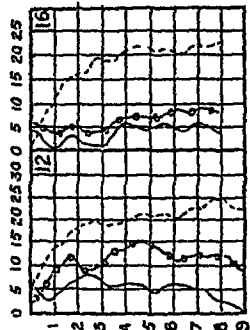
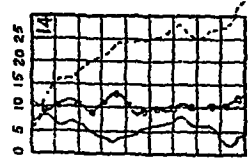
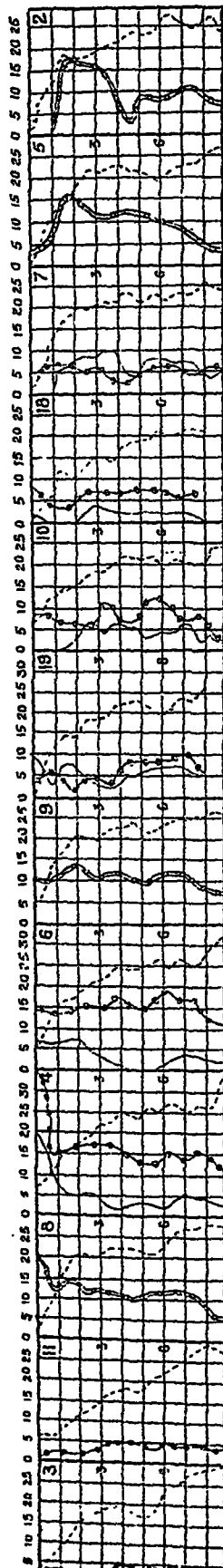
18. The same sets of specimens were employed for the purpose of ascertaining the seasonal variation in the percentage of salts as were used for the corresponding estimate of change of water content. The results are contained in statements VI and VII for Surajpur and VIII for Galpura. The charts representing these data are also of interest.

19. Considering first the point no. 10 at Surajpur (statement VI) it will be seen that the first two feet of the soil was found, in December, to be practically free from normal carbonate, below which the soil contained about .04 to .06 per cent. whilst the amount of bi-carbonate was greater but varied a good deal. Then six weeks later, the borings 12 and 13 contained more carbonate in the first two feet but much the same amount in the lower depths; of bi-carbonate they both contained distinctly more than no. 10 down to 5 feet, below which they are similar. Thus this evidence might be taken by itself to indicate a "rise of alkali" to the surface. Two months later nos. 16 and 17 were taken; of these no. 16 contained rather more normal carbonate in the first two feet than no. 10, but less than nos. 12 and 13; and of bi-carbonate there was less than in no. 10 or in nos. 12 and 13; secondly its fellow boring no. 17 contained, except for a trifling amount of alkali in the first 6", no normal carbonate in the first 3 feet and below that distinctly less than no. 10 and still less than Nos. 12 and 13. Thus the April specimens contained distinctly less alkali than the February ones. If the soil had been an "open" one and an adequate rainfall had intervened, such might have been urged as an explanation of the apparent change, but no such rainfall occurred. Lastly, six weeks later, in the middle of May, another pair of borings were taken, and of these no. 18 was very similar to no. 17 whilst no. 19 approximated as regards normal carbonate to no. 12, and as regards the bi-carbonate it is more like no. 16. Thus the more carefully these data are examined, the more certain it is that they show no appreciable concentration of alkali at the surface during the dry weather.

CHARTS ILLUSTRATING CONCENTRATION OF WATER AND ALKALI IN SURAJPUR USAR LAND.



ORDINATES : 1 UNIT = 1 FOOT
ABSCISSAE = CONCENTRATION
----- = WATER PER CENT.
———— = Na_2CO_3 PTS PER 10,000
—•—•— = NaHCO_3 " "



===== TOTAL ALKALI as CARBONATE

20. In an earlier paragraph (7) I concluded that the amount of water lost from these soils had been, over the same period, probably about 7 lbs per square foot, of which about $4\frac{1}{2}$ lbs is accounted for as coming from a greater depth than the first 6" of soil. If this water had brought its equivalent of salts with it, this would only be about .02 or .03 per cent. which should (theoretically) be in the first 6" of the soil in May. But such a quantity is well within the amount of "lateral variation," and hence it follows that no surprise need be experienced when the analyses of these various specimens still show towards the end of the hot weather, only lateral variation and no well defined upward movement.

21. Turning to the statement VII which shows the change of concentration near the point no. 8 Surajpur and to statement VIII in which corresponding data are given in respect of the usar patch at Galpura, we perceive precisely the same result; the lateral variation is greater than the seasonal variation, and consequently the latter cannot be ascertained with any precision in such soil.

SECTION V.

The rate at which water moves through these and through other soils.

22. From the first it seemed important to form a measure of the rate at which water moves through these soils. One reason will readily occur to the mind. If the question is asked whether the alkali cannot be washed out by flooding the land and allowing the water to soak through, the feasibility of the process could be gauged if we know whether the water can soak through within a reasonable time. Then again consider the plant. It assimilates water from the soil through its root; this water must move through a certain distance in the soil and it is easy to appreciate that if this water does not move fast enough, the plant will be unable to develop normally. It is true that the plant constantly sends out new roots in various directions; but it is easy to show that whatever such root development amounts to, it may nevertheless fall short of that which is required in a soil through which water moves say only 1/100 part as fast as through a good soil.

24. The only method which has been suggested for the purpose of determining the rate of flow of water through specimens of soil is one which Mr. Milton Whitney of the United States Department of Agriculture published in 1892 (Experiment Station Record, Vol. III, page 668 and Bulletin No. 4 United States Weather Bureau, 1892, page 37). This method consists in cutting a small block of the soil in an *undisturbed* state; this is then surrounded by wax, leaving the upper and lower faces clean; water is next poured on the top and the amount flowing through in a given time is measured. This method was tried for the Bhadan usar, but it proved defective for three reasons; (i) there was a difficulty in transporting the specimens intact, (ii) these frequently contained adventitious holes or cracks through which the water ran without properly percolating through the specimen, and (iii) it was frequently impossible to get an undisturbed specimen. It was important therefore, in order to test the soil properly, not only near the surface but also throughout the 9 feet stratum which was being examined for alkali, to try to devise a method which would not fail so frequently.

25. Short of undisturbed specimens of soil, the soil would have to be broken down entirely; this would necessitate its being filled into some description of percolating vessel, and this filling process must be performed so uniformly that the rate of percolation of the water through one specimen could be relied on to be fairly comparable with another. Filling the soil by hand seemed to be obviously so dependent on the operator that I considered a machine quite essential, and after consideration, the one which is described in appendix, p. 51 of this series of papers was made in the Pusa workshops.

As will be seen from the data to be considered, the apparatus has proved of great value, for by its means the thickness of these impervious beds of usar soil can be determined with considerable exactitude. After the soil (100 grms. has been used throughout hitherto) has been filled in, the cylinder is taken off the machine, placed over a suitable dish, water is poured on the upper soil surface, and after percolation has commenced, the rate of percolation is measured. The result is registered as centimeters per hour, in the same sense as rainfall per day is registered.

26. The first points which were tested were (i) the variation between duplicate tests made on the same soil by the same operator and (ii) the variation occasioned by two different operators, and the results are set out in statement No. IX.

STATEMENT—IX.

Depth.	V	V	M	V=Vishwanatham.
	I	II	I	M=Mukerji.

Rates of percolation, c. m. per hour.				
Soil—Galpura ‘usar’				
0"—6 "	·008—·010	·003—·005	·012—·027	
6"—12"	·002	·001	·002—·007	
12"—18"	·005—·007	·01 —·03	·004	
18"—24"	·002—·003	·003—·001	·002—·001	

Soil—Galpura ‘juar-arhar’				
0"—6 "	1·00	2·0—1·6	2·0—1·8	
6"—12"	1·2—1·0	1·2	1·3—·9	
12"—18"	·6—·8	·5 —·2	·6—·4	
18"—24"	·04	·05—·03	·4—·05	

Soil—Surajpur ‘usar’				
0"—6 "	·002	·01	·02 —·01	
6"—12"	·001—·003	·002	·007—·017	
12"—18"	·004—·01	·004—·01	·004—·019	
18"—24"	·001—·07	·002	·001—·002	

Soil—Surajpur ‘arhar.’				
0"—6 "	·85	·5—·4	·5—·4	
6"—12"	·5	1·0—·8	·8	
12"—18"	·5	·6	·7	
18"—24"	·4	·6	·5	

It includes tests of four soils ; one was usar from Galpura, and of this each four succeeding 6" depths was included. These find a place in the uppermost section of the statement. In column I we have the rates of percolation recorded by the one assistant in the first test ; thus water passed through the soil of the first 6" at the rate .008 to .01 cm. per hour ; through the second 6" rather slower namely .002 cm. per hour ; and through the third and fourth 6" at somewhat similar rates. Then in the second column are the data obtained some time subsequently by the same assistant with the same four specimens of soil ; these agree, as will be appreciated better when other records have been discussed, quite well ; the difference met with for the depth 12"—18" whilst not altogether inconsiderable, is not sufficiently great to prevent the correct deduction being made regarding the nature of the soil. Thirdly we have in the third column the rates measured for the same four soils by another assistant who had had no experience at all with the method. These data agree quite well with the others.

27. The second soil tested was from the same field at Galpura, but where a moderate crop of *juar-arhar* was growing ; again each of the four six-inch depths was tested, and comparison of the figures shows that the three tests agreed among themselves very well ; in only one case was there a discrepancy, namely in the test made by Bibu Mukerjee at the fourth depth where at first a high rate of percolation was met with, but which rapidly fell to a quantity closely approximating to what Mr. Vishwanatham, the other assistant, had found.

28. It is also evident how very greatly these rates of percolation varied in the first 18" from those of the usar soil ; roughly speaking they are 100 times greater and it is in this way that much of the usar land differentiates itself physically from good soil.

29. In the lower half of the statement are set out precisely similar tests on (i) the soil of a patch of usar at Surajpur and (ii) neighbouring soil where *arhar* was growing well. Here again it is evident how closely the data agree for the same soil when obtained by the same operator at different times or by another operator. The method undoubtedly commands confidence.

30. Another feature may be noticed also here. The soil of the Galpura field where the *juar-arhar* was growing is good throughout the first 18", but in the next 6" becomes bad, nearly as impervious to water as the usar soil, that is, the crop was struggling to grow in the top 18" of soil, and was consequently a poor one. At Surajpur on the other hand the good soil is pervious to water throughout the 2 feet. examined and, as was ascertained from other tests, there was no "usar" bed within the root range, and hence the plant had no difficulty in developing very perfectly.

31. It may be stated now that *according to this test* water percolates through a good arable soil or sub-soil at a rate of .3 up to 1.0 cm. per hour, and all comparisons for the purposes of the present memorandum may be made on this basis. This rate is higher (about three times as high) than probably occurs in the field during wet weather, but the difference, such as it is, is explained for the most part by the conditions of the experiment ; moreover this does not detract from the value of the tests for comparative purposes. For example, I have no doubt at all that water would percolate through these usar soils only 1/10 to 1/100 part as fast as through good soil.

32. It will be convenient in the next place to set out the results of the tests which have been made on various soils by means of this method.

Surajpur usar, 17th Boring.

Depth.	Cm. per hour.
0"—6"	·04
6"—1'0"	·03
1'0"—1'6"	·05
1'6"—2'0"	·004
2'0"—2'6"	·03
2'6"—3'0"	·03
3'0"—3'6"	·01
3'6"—4'0"	·03
4'0"—4'6"	·05
4'6"—5'0"	05
5'0"—5'6"	·02
5'6"—6'0"	·02
6'0"—6'6"	·03
6'6"—7'0"	·01
7'0"—7'6"	·02

Without making any distinctions between rates of percolation at 1' 6"—2' and above and below it, or between the rate ·01 at 3'—3' 6" and its neighbouring soil, it is evident that this soil is very impervious to water. Some soils are worse it is true, but this one falls far short of the standard of a good soil.

It is approximately uniform down to 7' 6" below which no test was made. As judged by the eye this land is highly impervious down to about 9 feet.

Galpura usar, 6th Boring.

Depth.	Cm. per hour.
0"—6"	·03
6"—1'0"	·04
1'0"—1'6"	·06
1'6"—2'0"	·02
2'0"—2'6"	·006
2'6"—3'0"	·01
3'0"—3'6"	·02
3'6"—4'0"	·01
4'0"—4'6"	..
4'6"—5'0"	·06
5'0"—5'6"	·03
5'6"—6'0"	..
6'0"—6'3"	·05
6'3"—6'9"	·15

This soil possesses much the same feature as that at Surajpur; although not being as impervious as some soils, it falls far below the standard of a good soil. The test further shows it to improve at 6' 9", which was where the soil was supersaturated with water. It is probable that the soil is quite pervious below this depth.

33. A number of other examples of the permeability of soils for water will be quoted in subsequent paragraphs, but that of Juhi may be examined here, because this soil was employed very early, as a test of the method. The Juhi usar reserve is a patch of land which is infertile but contains only small amounts of alkali salts and is highly impervious to water. Among various experiments which have been made there during the past 20 years, is one in which tree planting was tried, the trees being planted in holes, which latter were I think said to be filled up with good soil.

STATEMENT No. X.

Showing the perviousness of the Juhi usar soil.

Depth.	(i)	(ii)	(iii)
Cm. per hour.			
0'—6"	·005	·005	·015
6"—1'	·002	·005	·01
1'—1½'	·007	·001	·001
1½'—2'	·002	·007	·003
2'—7½'	·003	·005	·001
2½'—3'	·034	·004	·02
3'—3½'	·006	·006	·01
3½'—4'	·003	·012	·01
4'—4½'	·010	·010	·02
4½'—5'	·03	..	·07
5'—5½'	·11	·03	·16
5½'—6'	·8	·18	·6
6'—6½'	·8	·4	·8
6½'—7'	·7	·4	·7
7'—7½'	·6	·5	·7
7½'—8"	·5	·4	·6

Among the trees which have grown well are some dhaks (*butea frondosa*). I thought it likely, since they had grown so well, that these trees had changed the nature of the soil both laterally and vertically by means of root action, and if so, such change might be expected to affect the physical nature of the soil and make it more permeable. Accordingly Mr. Burt and I took borings to a depth of 8 feet (i) as close as possible to the trunk of a dhak tree (ii) 12" away from it and (iii) 12 feet away. No. (ii) was supposed to be within the original "tala" and of course no. (iii) was outside of it, and hence in ostensibly undisturbed land.

34. The results of the percolation tests are set out in the statement no. X, and a glance at these shows that laterally there is no difference in the soil; it is all *very* impervious to water to a depth of 3 feet and not much better until 5 feet is reached, but below this the soil changes markedly and becomes as "open" as the best arable land almost immediately. There is no indication that the soil of the original "tala" is different from the rest, nor has root action affected the soil at all. The presumption is that the dhak trees have forced a tap root through this impervious upper 5 feet of soil from which the tree has then developed its lateral root-system in the underlying good soil. This is of course a *presumption*, and its verification or otherwise will be of interest.

35. Before passing to the next subject, consideration may be here given to the possibility of reclaiming these soils by flooding and draining.

Many large areas of saline land have been reclaimed by (i) making substantial "bunds" on the land (ii) filling these "kiaris" with water say 2 or 3 feet deep and (iii) providing for under-drainage if the water will not pass away downwards altogether. If the soil is an "open" one no difficulty is experienced; it is a simple engineering operation.

36. But suppose the method were applied to such impervious soils as those we are dealing with. Assuming that the water would percolate at about 1/10 the velocity of ordinary soils, this would be about .2" per day; *in the soil* this .2" would occupy a space equal to about .6"; hence it might be said that the first water would pass

through 5 feet of soil in 100 days, by which time about 20" of water would have soaked in. In addition to this, one has to allow for evaporation which would be naturally taking place. The amount of this varies with the season; at Pusa the record shows it to vary from .06" per day in the cold weather to about .4" in the hot weather. For our present purposes it may be put at .2" per day throughout the year, which is equal to 20" for 100 days, and hence for the case we are considering we would require 40" of water on the surface before the first drainage occurred at 5 feet. Moreover the alkali would not be washed out until some considerable drainage had occurred, probably 10", which would occupy another 50 days, and this would demand another 20" of water at the surface. No difficulty would be experienced in providing such an amount of water; nor would the bunds, say 2 feet high, cost very much. So that, providing the drainage water could be got rid of naturally, or at no great expense artificially, the method might be considered feasible. On the other hand if the soil were more refractory and allowed water to percolate only 1/100 part as fast as through good soil, the water lost by evaporation would be 10 times that which is allowed for in the above calculation, and the time required would be ten times as great. In short whilst in the first example land might be reclaimed in 6 months, in the second 5 years would be required. It is also to be recollected that the impervious stratum of soil is frequently more than 5 feet thick.

Naturally if flooding and drainage are feasible, this method is the cheapest of all for the reclamation of alkali land.

SECTION VI.

The nature of sterile patches in non-canal irrigated villages.

37. A common feature in villages near Bhadan which are not irrigated by the canal is the presence in them of sterile patches of land which are precisely similar in appearance to those within the canal-irrigated tract. It would be unsafe to say that such patches occur as frequently in the former as in the latter, but they are certainly very numerous. These lands are under well-irrigation and the water level in wells is considerably further from the ground level than in the canal-irrigated tract.

STATEMENT XI.

Showing the perviousness of the soil in good and bad soil in well-irrigated land.

Depth.	Bhadan village.		Ramsukh village.	
	Good.	Bad.	Good.	Bad.
Cm. per hour.				
0"—6"	.9	.05	1.1	.9
6"—1'	1.0	.04	1.2	1.0
1'—1½'	.5	.03	.9	.7
1½'—2'	.04	.02	.6	.7
2'—2½'	.03	.004	.5	.5
2½'—3'	.02	.02	.4	.3
3'—3½'	.03	.02	.25	.2
3½'—4'	.8	.03	.4	.3
4'—4½'	.7	.03	.4	.4
4½'—5'	.8	.04	.8	.4
5'—5½'	1.3	.01	.8	.7
5½'—6'	1.0	.04	.8	1.0
6'—6½'	.8	.01	.9	1.2
6½'—7'	.6	..	.6	.9
7'—7'	4.0	.01	.6	.6
7½—8'	7.0	..	.4	1.7
8'—8'	18.0	..	.6	4.0
8'—9'	5.0	.25	1.5	.9

STATEMENT XII.

Showing the amount of sodium carbonate and bicarbonate in good and bad soil in well-irrigated land (Sodium carbonate in *red ink*, sodium bicarbonate in *black figures*).

Depth.	Bhadan village.		Ramsukh village.	
	Good.	Bad.	Good.	Bad.
0'-6' {	<i>nil</i> ·04	·06 ·04	<i>nil</i> ·03	<i>nil</i> ·03
6'-1' {	<i>nil</i> ·02	·07 ·05	<i>nil</i> ·02	<i>nil</i> ·02
1'-1½' {	<i>nil</i> ·01	·09 ·06	<i>nil</i> ·01	<i>nil</i> ·02
1½'-2' {	<i>nil</i> ·02	·08 ·05	<i>nil</i> ·02	<i>nil</i> ·01
2'-2½' {	<i>nil</i> ·02	·07 ·05	<i>nil</i> ·01	<i>nil</i> ·01
2½'-3' {	<i>nil</i> ·01	·07 ·05	<i>nil</i> ·01	<i>nil</i> ·01
3'-3½' {	<i>nil</i> ·01	·06 ·04	<i>nil</i> ·01	<i>nil</i> ·01
3½'-4' {	<i>nil</i> ·04	·05 ·04	<i>nil</i> ·01	<i>nil</i> ·01
4'-4½' {	<i>nil</i> ·04	·04 ·05	<i>nil</i> ·01	<i>nil</i> ·01
4½'-5' {	<i>nil</i> ·04	·04 ·05	<i>nil</i> ·01	<i>nil</i> ·02
5'-5½' {	<i>nil</i> ·04	·06 ·05	<i>nil</i> ·01	<i>nil</i> ·01
5½'-6' {	<i>nil</i> ·04	·05 ·04	<i>nil</i> ·01	<i>nil</i> ·01
6'-6½' {	<i>nil</i> ·04	·01 ·05	<i>nil</i> ·01	<i>nil</i> ·01
6½'-7' {	<i>nil</i> ·04	·02 ·08	<i>nil</i> ·01	<i>nil</i> ·01
7'-7½' {	<i>nil</i> ·04	·02 ·08	<i>nil</i> ·01	<i>nil</i> ·01
7½'-8' {	<i>nil</i> ·02	·01 ·05	<i>nil</i> ·01	<i>nil</i> ·01
8'-8½' {	<i>nil</i> ·02	·01 ·07	<i>nil</i> ·01	<i>nil</i> ·01
8½'-9' {	<i>nil</i> ·03	·01 ·05	<i>nil</i> ·01	<i>nil</i> ·01

38. I decided to take samples of some of these patches because it is obviously no little importance to know in how far they differ from the apparently similar ones of the canal-irrigated tract. The matter could only be gone into to a limited

extent and only two such patches were tested; these were situated in Bhadan and Ramsukh villages respectively. The tests included in each case a boring 9 ft. deep from a bare patch and a similar one from the good soil adjoining. The results of the examination are set out in statements XI and XII, the former of which shows the results of the percolation tests and the latter the amount of "carbonate and bi-carbonate" in the soil.

39. An inspection of the data contained in these two statements shows at once that the result of the test is contradictory. The soil of the "usar" patch in the arhar field in Bhadan village is highly impervious to water and contains as much sodium carbonate and bi-carbonate as many of the specimens taken at Surajpur; whilst the adjacent soil where the arhar crop was good was readily pervious to water excepting from 1' 6" to 3' 6". Thus the soil of this usar patch has all the characteristics of the usar land of this part of India. The corresponding test in the neighbouring village Ramsukh-ki-madarya disagrees entirely with the former, in that both the "good" and "bad" soils were found to be freely permeable to water, neither contained any normal carbonate, and the amount of bi-carbonate present is very small. The crop on this field was barley and gram, which had been sown on the "bad" soil but had died out again. It may be of course that the soil was good just where the boring was taken, for the erratic manner in which the nature of these patches varies from point to point has been fully exemplified by the Surajpur tests, or it may be that these barren patches are not always so bad as they appear. Be this as it may, it is evident that some of them are sterile from the same causes as those in canal-irrigated villages, and that this branch of the subject is of great importance.

SECTION VII.

The nature of the canal water and its possible effect on these soils.

40. Canal irrigation is constantly blamed for the *formation* of alkali land; it has been said that it causes a serious rise of the sub-soil water level and that it adds "usar salts" to the soil. Besides these two charges another question may be properly asked, namely, whether it causes *certain* soils to become less pervious to water. I shall only refer to the two latter matters.

41. As regards the suggestion that canal water adds alkali salts to the land; this is made on the assumption that additions of the water at the surface bring *some*, however little, sodium salts into the soil; that these don't drain away, but that the water evaporates again, leaving these small accumulations of salts year by year behind. The following is an analysis of the canal water at Bhadan:—

	Parts per 100,000.			
Calcium carbonate	8.0
Magnesium carbonate8
Magnesium sulphate	1.2
Sodium sulphate	2.8
Sodium chloride5

42. Now it is one thing to make the above suggestion, but it is quite another to substantiate its correctness. Assuming the soil to be in the first instance a normal arable soil, and that about 12" or more of irrigation water is employed, there is every reason to believe that drainage would occur annually, and it is easy to show that no accumulation of the sodium salts would occur. On the other hand, if a soil is originally highly impervious to water, then drainage would be imperfect or altogether absent and some accumulation might be held to occur; but even so, such accumulations would be annually so small that a long series of years must elapse before the land could become *on this account* "usar."

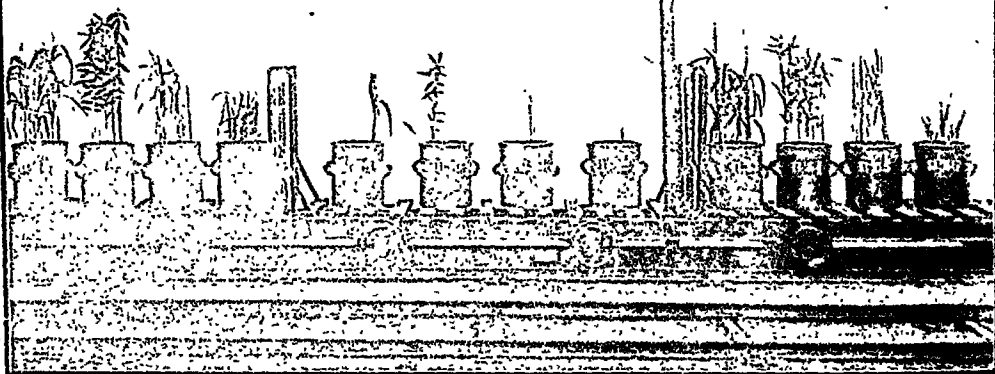
43. Then again we have the indisputable evidence that patches of sterile soil, possessing all the attributes of those within the canal-irrigated area, occur in the well-irrigated tract, and this fact alone naturally raises the question whether the canal irrigation has had anything at all to do with the creation of these sterile patches in the former area.

USAR EXPERIMENTS 1910
TEST OF EFFECT OF COMMON SALT
ON A SOIL

NO SALT

25 PER CENT SALT

1 PER CENT SALT

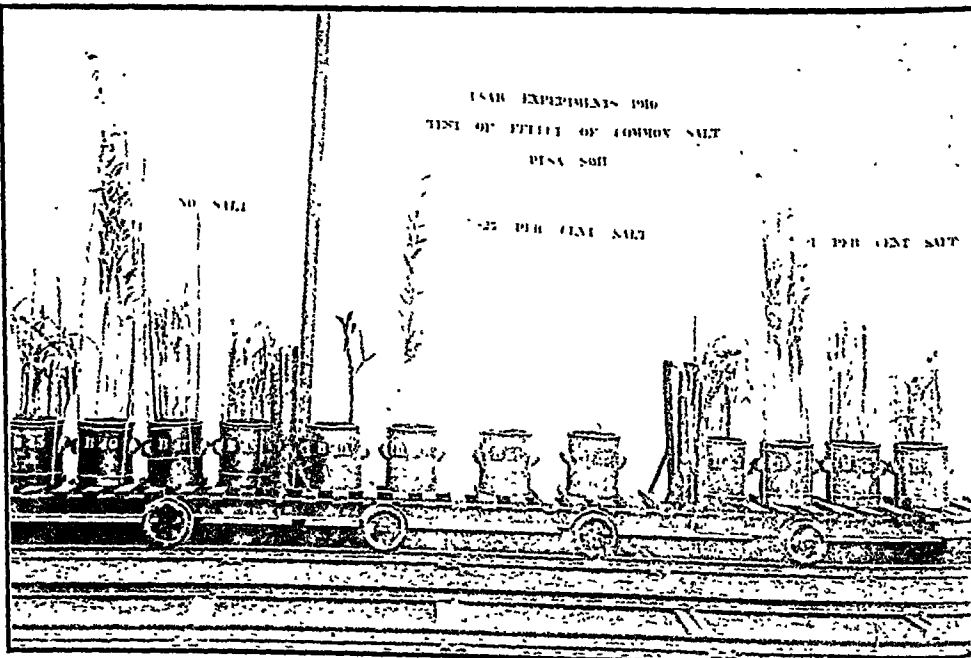


USAR EXPERIMENTS 1910
TEST OF EFFECT OF COMMON SALT
ON A SOIL

NO SALT

25 PER CENT SALT

1 PER CENT SALT



48. Another possible suggestion which I considered is the deliberate addition of some coagulating substance to the canal water. If this were feasible, it could be done at a canal head works much more perfectly and probably more cheaply than in the field; but any such addition would mean that the canal bed would become more pervious to water and hence cause percolation, which is already too great, to increase.

SECTION VIII.

The nature of the drainage water.

49. The "drainage" water of the Sirsa Nadi, as also the "sub-soil" water in certain fields has been examined. The Sirsa Nadi is I presume a natural drain during the dry season; that is its supply must be a natural sub-soil drainage one. Its composition in May was that which is marginally stated. It contains no sodium carbonate, but comparatively large amounts of sodium chloride and sulphate. These features show quite clearly that it is not fed by drainage from "black"

alkali land. If, for example, drainage is occurring into it from such canal-irrigated tracts as those at Surajpur or Galpura, such water must be coming from a non-alkali stratum.

50. The sub-soil water of three fields was tested, samples being withdrawn from bore-holes about 9 feet deep and the analyses are quoted in statement XIV.

STATEMENT XIV.

Composition of sub-soil waters.

(Parts per 100,000.)

				From wheat field.	From Surajpur usar.	From Galpura usar.
Calcium carbonate	..	...	..	18.0	1.0	3.0
Magnesium carbonate	..	..	..	10.9	..	..
Sodium bi-carbonate	..	..	..	..	146.4	156.0
Magnesium sulphate	..	..	..	6.1	..	..
Sodium sulphate	..	..	..	1.9	10.4	5.5
Sodium chloride	..	..	..	2.1	6.5	2.8

These figures are very instructive. The water from the wheat field is free from sodium bi-carbonate, whilst that of the usar land contains very large amounts of this salt. That there is practically no movement of these waters laterally is almost proved by the fact that the first two specimens were within a few feet of one another. Moreover, strongly alkaline as the sub-soil water of the usar patches is, it is considerably weaker than the corresponding solution in the soil higher up, and indicates that, assuming canal water to have come upwards from below, it has not increased but on the contrary has decreased the alkalinity, which is what one would expect.

Conclusions.—The conclusions which I have drawn from the investigation so far as it has gone may be stated thus:—

(i) The land in the neighbourhood of Bhadan is in patches very impervious to water; these patches also contain a certain amount of sodium carbonate and bi-carbonate but no other "usar" salts. The whole of the country is apparently water-logged at about 7 to 9 feet from the surface, and this is naturally a disadvantage.

(ii) During the dry season the soil of the usar patches dries at the immediate surface, but from about 12" deep down to 6 or 7 feet it remains as wet as at the end of the moonsoon. The amount of water present in this stratum is not excessive. Below this depth the determinations of soil

moisture are uncertain, but judging by the eye the soil becomes drier at this depth during the dry season, which is the natural accompaniment of a seasonal fall in the sub-soil water level, and at the same time indicates a free movement of water through the soil at these depths. In fact the evidence goes to show that the sub-soil water can rise and fall freely *below* the impervious patches of usar soil which are some 7 or 8 feet thick.

- (iii) Nothing in the nature of a "saline-substratum" was met with nor is there any reason to suppose that one exists. The "alkali" in the soil is doubtless a product of the soil itself. Although some "rise of alkali" towards the surface during the dry weather must take place, this is so small in these soils that it could not be measured.
- (iv) There are sterile patches of soil in non-canal irrigated land, of a description similar to those in the canal-irrigated area. These have not been examined very fully, but the evidence so far obtained from an examination of these soils and of the canal and well waters indicates that the canal water could not possibly *create* such patches. The question is however raised whether the canal water, owing to its very purity, may have aggravated the defects of this class of soil.
- (v) The composition of the water of the Sirsa nadi in the hot weather indicates that it is not fed by drainage from "black alkali" land. If then it receives sub-soil drainage from the area under the Bhognipur branch, such drainage water must be drainage from *below* the usar patches and is a proof of the isolated position, in respect of all drainage, of these usar patches.
- (vi) The rate at which water will flow through these impervious soils has been measured and the conclusion drawn that, assuming the sub-soil water level of this tract to be first lowered, it might be possible to reclaim some of these lands by maintaining about 2 feet of water on the surface, but that the period required would probably be some 6 to 12 months. If the sub-soil water level cannot be lowered, then open drains or other artificial means of removing drainage water would be necessary. On the other hand these usar patches are often so impervious to water that mere flooding would probably fail to be effective.

**Report II.—Usar investigations at Aligarh by Dr. J. Walter Leather,
Imperial Agricultural Chemist, November 1910.**

In paragraph 1 (vi) of my previous report forwarded with my letter no. 385/1-2, dated the 3rd September 1910, to the address of the Director, Land Records and Agriculture, United Provinces, on the results of investigations on usar soil of the United Provinces, it was mentioned that some tests were being made on the soil of land near Aligarh, where reclamation experiments have been in progress for some years.

There are two areas of usar land near Aligarh which were enclosed some 25 years ago and which have been subsequently subjected to one process or another for their reclamation. The one is at Cherat and this is now the site of Mr. Keventer's Dairy Farm. Here he has brought a great deal of the land under cultivation, though only a small part of it grows crops other than rice. The other area is at Gursikran, and here various methods other than simple cultivation have been tried for the transformation of the unculturable usar into good land. The following is a statement of the several methods with which we are concerned:—

- (i) *Ordinary cultivation coupled with very heavy manuring*; employed by Mr. Keventer at Cherat. It is impossible to state how much manure has been annually used, but the quantity has been far in excess of what any ordinary farmer could afford. At the Dairy Farm there is a large amount of such farm manure and liberal supplies of water; there is also no good land near by, and hence it happens that to put it on this land is the most economical way of disposing of it. The land has been producing good crops for some years now.
- (ii) *Application of gypsum*.—This mode of converting usar into good soil has been tried on several plots at Gursikran. There is no doubt that if gypsum is used in sufficient amount and if it can be brought into contact with the usar soil throughout its entire depth of several feet, the sodium carbonate would become converted into sodium sulphate and the clay coagulated; at the same time not only is the quantity of gypsum required for the purpose large (it amounts to tons per acre) and is thus very expensive, but it can only come into contact with the soil below the ploughed stratum in the water which may annually soak downwards, and since this soil is highly impervious to water, the process must be in any case a very slow one.
- (iii) *Scraping off the saline efflorescence annually*.—The salty efflorescence has been removed twice a year from the surface of $\frac{1}{2}$ acre since 1902.
- (iv) *Salt bushes* have been grown on one patch of land for several years.

It was felt that if these several areas of land were tested (a) for their permeability to water and (b) for the amount and nature of salts now present, an opinion could be formed as to how far the methods enumerated had affected the soil. Accordingly in March 1910 samples of soil to a depth of 9 feet from the surface were taken in 6" portions and subsequently examined. In dealing with the results of this examination it will probably be most convenient to take each case separately and to draw general conclusions afterwards. It is necessary to remark however in advance that although, for comparison's sake, samples were taken this year in the original land near each experiment, it is doubtful in how far such samples are really useful for purposes of comparison. In the report dealing with the soil at Bhadan, very exhaustive evidence was produced, which showed to what a great extent the nature of these soils varies from foot to foot; and it consequently follows that a sample taken in the untreated usar land adjoining the site of any experiment may form in fact no dependable comparison at all, and this fact renders deductions in relation to the experiments at Aligarh very difficult. There is only one reliable mode of making

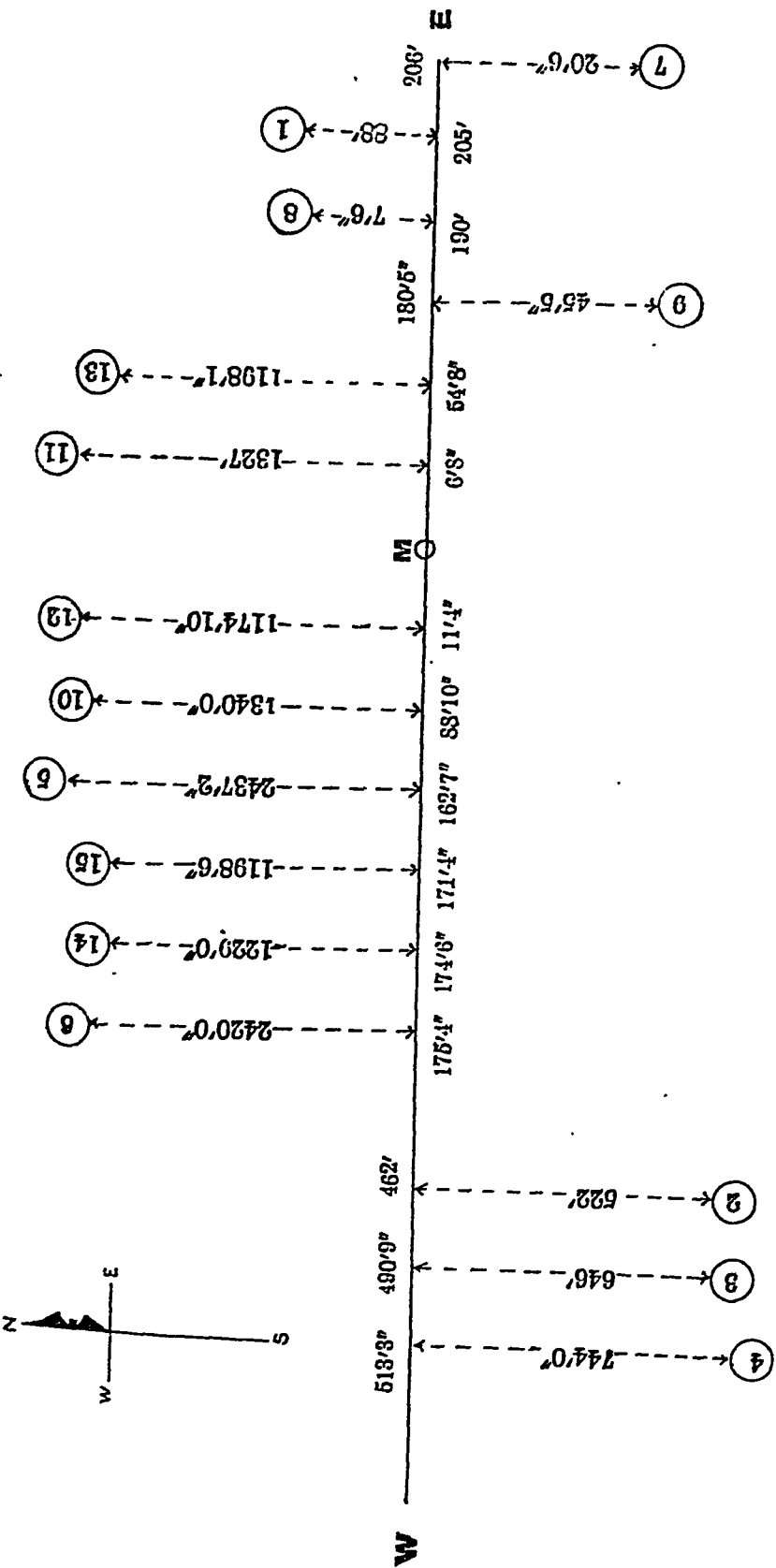


Diagram showing the positions of certain points within the Gursikran Usar Farm where samples of the soil were taken in 1911.

The point M is 16' 6" from the N. E. corner of the bungalow and at right angles to the N side.
 The numbers within circles are the boring numbers.

such comparative tests, namely to test the soil of the plot at the commencement of an experiment at several points, to register the position of these points and then at the conclusion of the experiment to test the soil again at other points closely contiguous to the first. When the experiments at Aligarh were commenced, the boring tool which we now possess had not been devised, and any samples that were ever taken in usar had to be obtained from large holes so wide indeed that no subsequent sample could be usefully taken near the first. This explanation will, it is hoped, enable those who are not conversant with the difficulties of making comparative tests in usar land, to understand their nature.

Experiments at Cherat.

Dairy Farm, Cherat.—At the Dairy Farm samples were taken from (i) a patch of partly reclaimed land, (ii) original land near by, (iii) original usar in the plain and (iv) land brought under cultivation a number of years ago and very heavily manured.

All this land is exceedingly impervious to water down to 9ft. Even that on which heavy crops have been produced for some years holds water on the surface like the uncultivated usar. Chemically the least obnoxious land is the original usar (no. 3) for it contains practically no normal carbonate below 2ft. from the surface and very little other salts. The heavily manured land (no. 4) contains some normal carbonate throughout, commencing at 1' 6" from the surface. No. 2, which is original usar, is much the most saline, and the amount of carbonate and bi-carbonate in the top soil is very large, whilst below 4ft. these become nominal. The partly reclaimed soil contains a good deal of normal carbonate between the second and seventh feet.

An examination of the data in statement No. 1 indicates that in the cultivated soil there has been some movement of the salts downwards, and this is only to be expected in land which is well tilled, shielded largely from evaporative influences, and constantly irrigated. On the other hand it is certain that even after many years of such treatment this washing process has not removed the salts very far. For instance supposing No. 4 to have been originally similar to No. 3 or No. 2 with its carbonate concentrated in the upper 2 to 3ft., then since there is an indication that the salts are much less in the 9th foot than above it, the effect of a long term of years of cultivation and irrigation may be said to have been a distribution of this salt through the first 9ft. Bearing in mind the very impervious character of the soil, such a result is not surprising. On the other hand it is surprising that the effect of crop roots and manure on at least the upper soil has been so slight. Less than 1ft. has been changed physically and made freely permeable to water. Only one conclusion can be drawn in respect of this experiment, namely that the topmost soil has been reclaimed and that the crops which are annually produced live almost entirely on this stratum; a conclusion which is supported by the fact that the crops require constant (weekly) irrigation. It has been to me an unexpected result.

STATEMENT NO. 1.—*Dairy Farm Usar.*

Depth ft.	No. 1 partly reclaimed.					No. 2 original Usar near No. 1.					No. 3 original Usar outside cultivation.					No. 4 land brought under cultivation by Mr. Kevanter and heavily manured.				
	Salts.					Salts.					Salts.					Salts.				
	Percolation am. per hour	Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %	Percolation am. per hour	Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %	Percolation am. per hour	Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %	Percolation am. per hour	Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %
0—1	..	.084	.111	..	..	.034	.780	.423	.021	nil	.011	.074	.077	.002	.016	.1	nil	.073	.023	.015
1—1	.009	.084	.080	..	..	.032	.213	.083	.021	nil	.002	.089	.002	.002	.012	.002	.002	.086	.011	trace.
1—1½	..	.069	.077	..	..	..	.143	.068	.018	nil	..	.069	.018	.003	nil	..	.013	.009	.009	nil
1½—2	.020	.080	.086	..	..	.007	.110	.152	.010	nil	.008	.080	.080	.002	nil	.007	.034	.073	.011	nil.
2—2½	..	.120	.077	..	..	..	.099	.080	.009	nil	..	.006	.050	.003	nil	..	.030	.084	.011	nil.
2½—3	.007	.142	.077	..	..	.007	.070	.087	.005	nil	.002	nil	.051	.003	nil	.004	.034	.105	.011	nil.
3—3½	..	.141	.080	..	..	..	.044	.081	.007	nil	..	.004	.002	.002	nil	..	.038	.110	.009	nil.
3½—4	.032	.107	.053	..	..	.007	.013	.031	.002	nil	.009	nil	.002	.003	nil	.004	.030	.099	.009	nil.
4—4½	..	.215	.105	.033	.018	..	.003	.085	.002	nil	..	.010	.003	.003	nil	..	.029	.092	.009	nil.
4½—5	.013	.270	.143	.035	.021	.012	nil	.017	.003	nil	.008	.004	.009	.003	nil	.002	.036	.089	.009	nil.
5—5½	..	.277	.117	.035	.021	..	nil	.014	.003	nil	..	nil	.009	.003	nil	..	.036	.073	.009	nil.
5½—6	.007	.232	.104	.034	.037	.048	nil	.011	.002	nil	.001	nil	.051	.003	nil	.006	.036	.077	.009	nil.
6—6½	..	.118	.093	.030	.021	..	nil	.014	.003	nil	..	nil	.017	.003	nil	..	.034	.081	.007	nil.
6½—7	.013	.077	.008	.035	.027	.015	.010	.002	.005	nil	.00	nil	.017	.003	nil	.004	.034	.051	.009	nil.
7—7½	..	nil	.061	.028	trace	..	nil	.036	.005	nil	..	nil	.057	.003	nil	..	.039	.072	.007	nil.
7½—8	.038	.002	.050	.023	trace	.035	nil	.034	.007	nil	.004	nil	.017	.003	nil	.003	.033	.063	.007	nil.
8—8½	..	nil	.060	.014	nil	..	nil	.018	.005	nil	..	..	.014	.003	nil	..	.013	.055	.008	nil.
8½—9	.043	nil	.015	.009	nil	.1	nil	.018	.005	nil	.007	..	.014	.003	nil	.137	.008	.038	.003	nil.

Experiment at Gursikran.

Eff. raised salt scraped off the land.—In 1902 two plots of $\frac{1}{2}$ acre each were enclosed with small bands; from one the salts were scraped off each year in February and again in May, whilst the other has been left intact. The scrapings were not weighed until February 1906, and we have only rough estimates for the first four years; also no weight was taken in 1907. These guessed weights are marked in statement No. II with an *. The quantities recorded in 1906 and subsequently, demonstrate two facts very clearly; these being (i) the quantity removed each year has decreased very rapidly and (ii) the quantity removed in May is far smaller than that removed in February. These two features are what one might expect. The greater the amount of salt present in these impervious soils, the more permeable they are to water. Hence while the amount of salts was large the annual rain would penetrate deeper into the surface soil than subsequently, and accordingly there would be more water to move upwards during the dry weather which might be expected to bring with it larger amounts of salts. Also, since these soils are so impermeable to water, the drying out process could not be expected to last very long. Most of the water that could move upwards would pass out during the first few months of the dry weather, and one can readily understand that little would be left after February to bring up further quantities of salts. Thus, whilst there is no doubt that the upward movement of water continues throughout the dry weather, the quantity moving in unit time during the latter part of the dry weather would fall to a small figure. The weighed quantities of scrapings recorded during later years agree with expectations.

For 1907, when the scrapings were not weighed, I have assumed a quantity for February which, judging by the data for 1906 and 1908 and subsequent years, is probably not far from the truth. It may have actually been nearer 100 than 90 tons, but the difference is not very material.

STATEMENT NO. II.

Details of scrapings from plot at Gursikran. Quantities stated per acre.

Date.	Quantity tons.	Salts.	
		%	tons.
1902	148*	5.8	7.85
1902 November	75*	1.0	.75
1903 February	75*	5.2	3.90
1903 May	75*	1.5	1.12
1904 February	75*	4.9	3.68
1904 May	75*	3.7	2.78
1905 February	75*	2.8	2.10
1905 May	75*	1.6	1.20
1906 February	100	3.2	3.49
1906 May .. .. .	.2	1.5	..
1907 February	90*	3.7	3.88
1907 May .. .. .	..	6.0	..
1908 February	68.4	3.0*	2.05
1908 May .. .. .	.2	3.7	..
1909 February	16.6	2.8	.45
1909 May .. .. .	.8	1.9	..
1910 February	5.8	3.8	.20
1910 May .. .. .	.7	2.0	..
..	..		82.90

The scrapings have been analysed each year except in February, 1908, and the details are set out in statement No. III. From these and the quantities of scrapings removed it would be simple to calculate the quantity of each of the three salts, the carbonate, sulphate and chloride of sodium respectively, which has been removed; but having regard to the fact that the recorded quantities of scrapings are only known approximately, no useful object would be served in carrying out the calculations in such detail. The removed salts have generally contained more carbonate than sulphate and considerably less chloride. The requirements of the case will be sufficiently met if, from the data available, the total amounts of the three salts are calculated for each year, and these quantities are set out in the last column of statement No. 2. The estimate of total salts removed per acre is about 33 tons.

STATEMENT No. III.

Showing the composition of the reh scrapings, 1902-10 at Gurrikiran usar.

Month and year.						Results of analysis.		
						Sodium carbonate.	Sodium sulphate.	Sodium chloride.
						%	%	%
February 1902	..	..	..	..	..	2.75	2.22	.29
November 1902	..	..	..	..	..	.54	.74	.23
February 1903	..	..	..	..	..	2.427	2.410	.381
May 1903	..	..	..	..	..	.869	.530	.110
February 1904	..	..	..	..	..	1.13	2.50	.10
May 1904	..	..	..	..	..	.40	1.38	.18
February 1905	..	..	..	..	..	1.554	.968	.234
May 1905	..	..	..	..	..	1.004	.435	.136
February 1906	..	..	..	..	..	1.752	1.173	.235
May 1906	..	..	..	..	..	.776	.426	.294
February 1907	..	..	..	..	..	2.423	.987	.261
May 1907	..	..	..	..	..	3.41	2.01	.53
February 1908	..	..	The sample does not seem to have been sent for analysis.					
May 1908	..	..	..	..	..	2.23	1.13	.36
February 1909	..	..	..	..	..	1.65	.93	.18
May 1909	..	..	..	..	..	1.22	.37	.33
February 1910	..	..	..	..	..	1.706	1.420	.830
May 1910	..	..	..	..	..	1.19	.69	.22

In March last this scraped plot and also the neighbouring unscraped plot were sampled to a depth of 9 feet. The borings were taken from a point almost exactly at the centre of each plot. The analytical data obtained from an examination of the soil of each 6" are set out in statement No. IV.

Considering first the permeability to water, the scraped plot is highly impermeable in the first foot, and then becomes more permeable until, below 4 feet, the soil is very nearly normal in this respect. The unscraped plot is freely permeable below 5 feet.

From the percentage of the several salts found by analysis and the known weight of soil per cub. foot, the total quantity of each of the salts present in the soil can be calculated for each plot. The quantities so found are, in tons per acre, as follows:—

		Na ₂ CO ₃	Na Cl	Na ₂ SO ₄	Total
Scraped land	..	14	3	5	22
Unscraped land	..	34	8	26	68

The bi-carbonate has been omitted because at the present time I am uncertain whether the quantities found for sodium bi-carbonate are really the sodium salt. Their inclusion would however make but little difference to the result. If 33 tons represents approximately the total removed in the nine years, it may be said that approximately $\frac{1}{3}$ of the salts have been taken out of the land. Regarding a comparison with the un-scraped plot, I have sufficiently shown in my first memorandum how much this near land varies in composition, and one can only assume that the land of the two plots was approximately alike in 1902. But the evidence provided now by the un-scraped plot lends support to the estimate of the proportionate amount of salts removed. One may at any rate draw the following conclusions from the experiments:—

- (i) Probably between $\frac{1}{2}$ and $\frac{2}{3}$ of the salts which were originally present has been removed by scraping for 9 years.
- (ii) The amount yielded annually at least during the later years has decreased rapidly and has become small.
- (iii) The amount still remaining in the soil is more than sufficient to prevent any crop from growing.

STATEMENT NO. IV.—*Gursikran usar.*

Depth feet.	Percola- tion cm. per hour.	No. 10 land scraped.				Percola- tion cm. per hour.	No. 11 unscraped.			
		Salts					Salts.			
		Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %		Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %
0—1	·004	·247	·053	·030	·110	·01	·464	·072	·076	·833
1—1	·01	·149	·054	·020	·058	·01	·252	·088	·047	·277
1—1½	·02	·131	·055	·021	·049	·01	·245	·072	·045	·240
1½—2	·01	·105	·059	·019	·033	·004	·255	·059	·049	·198
2—2½	·01	·037	·055	·019	·021	·008	·195	·105	·051	·143
2½—3	·01	·019	·056	·012	·018	·01	·135	·108	·014	·100
3—3½	·02	·027	·059	·011	·015	·01	·091	·039	·031	·082
3½—4	·05	·007	·041	·003	·005	·01	·028	·048	·031	·033
4—4½	·15	·002	·035	·005	trace	·02	·013	·018	·019	·024
4½—5	·2	nil	·035	·004	trace	·07	·011	·024	·015	trace
5—5½	·3	nil	·030	·002	trace	·2	nil	·033	·012	trace
5½—6	1·5	nil	·030	·002	trace	·2	nil	·041	·007	trace
6—6½	1·3	nil	·020	·002	trace	·08	·004	·038	·011	trace
6½—7	2·0	·002	·023	·002	trace	·25	·001	·027	·004	trace
7—7½	2·0	·004	·026	·002	trace	·40	·002	·031	·001	nil
7½—8	2·0	·002	·026	·002	trace	·7	·002	·027	·004	nil
8—8½	3·0	·004	·024	·002	trace	·15	·005	·035	·005	trace
8½—9	18·0	·002	·021	·002	trace	2·0	·004	·018	·002	trace

Plots treated with gypsum.—Of plots which have been treated with gypsum there are three, (a) includes four small plots which received gypsum in 1897, (b) and (c) two plots of about $\frac{1}{2}$ acre each which were treated with gypsum about 1902.

The four small plots referred to under (a) were marked off by Khan Bahadur Syed Mohammad Hadi in June 1897. Each measured 4 × 4 yds. that is 16 sq. yds.

in area and each was sampled to a depth of 2 feet. The analysis of the mixed earth yielded the following data :—

				Plot I.	Plot II.	Plot III.	Plot IV.
Na_2CO_3	..	..	..	·768	·561	·789	·477
Na_2SO_4	..	...	..	·045	·037	·054	·042
NaCl}	..	..	..	·011	·023	·046	·043

Pounds of gypsum, calculated as 90 % pure, required to neutralise the sodium carbonate in 1 sq. yd. of soil :—

27·6 19·9 28·4 17·1

The gypsum employed was found to contain 89·07 % $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. The quantities of gypsum dug into the surface soil of each plot in July 1897 were :—

Secrs. Secrs. Secrs. Secrs.
215 155 221 121

A small bund was made round each plot to prevent erosion of the freshly disturbed soil. It was found after the elapse of several years that one of the plots had become culturable and a good crop of wheat has been obtained from this each year. When the samples were taken in March last it was understood that wheat has failed to grow where sample No. 6 was taken. It is probable that this is a misapprehension and that the simple fact is that No. 6 has not been cultivated or sown at any rate in recent years. However this may be, the data relating to these soils, as set out in statement No. 5 show that they are as nearly alike as possible. Both are freely permeable to water for a depth of 12" to 18" from the surface, below which and down to a depth of about 7 ft. the soil is very impervious, though not so impervious as some usar lands are; below 7 ft. the soil is freely permeable to water. Of the salts present both soils contain much about the same amounts; sulphate and chloride are present in only small quantity which is concentrated towards the centre of the impervious stratum; the amount of bi-carbonate approximates to ·05% and varies only slightly with the depth; of

STATEMENT No. V.—*Gursikran Usur. Borings (Nos. 5 and 6) from old "gypsum" plots.*

Depth feet.	No. 5 wheat grows.					No. 6 wheat fails.				
	Percola- tion cm. per hour.	Salts.				Percola- tion cm. per hour.	Salts.			
		Na_2CO_3 %	NaHCO_3 %	NaCl %	Na_2SO_4 %		Na_2CO_3 %	NaHCO_3 %	NaCl %	Na_2SO_4 %
0—1	·4	nil	·049	nil	nil	·7	nil	·053	·001	nil
1—1	·9	nil	·043	nil	nil	·9	nil	·043	·001	nil
1—1½	·01	·011	·070	·001	nil	·6	nil	·039	·001	nil
1½—2	·01	·019	·022	·001	nil	..	·005	·054	nil	·012
2—2½	·02	·055	·090	nil	trace	·03	·032	·072	nil	trace
2½—3	·03	·068	·070	nil	trace	·03	·065	·054	nil	·005
3—3½	·01	·072	·061	nil	trace	·01	·082	·054	nil	·003
3½—4	..	·063	·066	nil	trace	·02	·072	·057	·001	·046
4—4½	..	·068	·072	·001	trace	·005	·063	·078	·005	·021
4½—5	..	·040	·066	·001	·015	·02	·051	·078	·005	·079
5—5½	·02	·030	·069	·003	·043	·02	·047	·076	·005	·097
5½—6	·02	·019	·058	·003	·049	·03	·032	·057	·005	·070
6—6½	·05	·009	·051	·003	·046	·03	·025	·063	·006	·070
6½—7	1 2	·004	·056	·002	·021	·07	·015	·051	·003	·018
7—7½	2·5	·009	·040	·001	·009	·8	·015	·046	·003	·018
7½—8	4 0	nil	·030	·001	·006	1·5	·003	·040	·003	·015
8—8½	4·0	·004	·037	·001	·006	1·7	·005	·036	·001	·009
8½—9	4·0	nil	·031	·001	·005	2·5	nil	·040	·001	trace

STATEMENT NO. VI.—*Gursikran Usar. Borings Nos. 12 and 13.*

Depth feet.	No. 12 treated with gypsum					No. 13 original land outside No. 12.				
	Percola- tion cm. per hour.	Salts.				Percola- tion cm. per hour.	Salts.			
		Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %		Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %
0— $\frac{1}{2}$	·002	·116	·031	·029	·207	·002	·319	·174	·062	·463
$\frac{1}{2}$ —1	·004	·103	·048	·019	·119	·02	·241	·187	·037	·289
1— $1\frac{1}{2}$	·008	·103	·047	·029	·149	·001	·245	·078	·038	·262
$1\frac{1}{2}$ —2	·006	·122	·051	·021	·123	·002	·245	·078	·038	·241
2— $2\frac{1}{2}$	·02	·187	·069	·024	·155	·02	·277	·050	·042	·251
$2\frac{1}{2}$ —3	·02	·141	·063	·022	·167	·01	·257	·025	·049	·228
3— $3\frac{1}{2}$	·01	·125	·084	·034	·180	·02	·169	·089	·019	·155
$3\frac{1}{2}$ —4	·03	·108	·074	·032	·148	·01	·040	·006	·019	·037
4— $4\frac{1}{2}$	·01	·078	·068	·032	·110	·1	nil	·039	·002	nil
$4\frac{1}{2}$ —5	·03	·038	·063	·028	·076	·15	nil	·036	·002	trace
5— $5\frac{1}{2}$	·02	·027	·059	·024	·049	·15	nil	·032	·002	trace
$5\frac{1}{2}$ —6	·05	·003	·039	·018	·018	·2	nil	·033	·002	trace
6— $6\frac{1}{2}$	·15	·002	·035	·009	trace	·2	nil	·032	·002	trace
$6\frac{1}{2}$ —7	·1	·004	·038	·009	·015	1·0	·004	·032	·004	trace
7— $7\frac{1}{2}$	1·0	nil	·030	·002	·006	2·0	nil	·029	·004	trace
$7\frac{1}{2}$ —8	·2	·004	·041	·003	·015	1·5	nil	·032	·003	trace
8— $8\frac{1}{2}$	1·5	nil	·032	·002	trace	2·0	nil	·029	·003	trace
$8\frac{1}{2}$ —9	·8	·004	·030	·002	trace	2·0	·004	·037	·003	trace

The third plot which was treated with gypsum is also near the last mentioned. Samples were taken in March from this plot and from the usar outside it. The results are set out in statement No. VII. The plot where No. 15 boring was taken has several trees on it and carries a cold weather crop, though this is a poor one I do not know how much gypsum was applied, but in this case (unlike the comparison between Nos. 12 and 13) the very marked decrease of normal carbonate and the considerable increase of sulphate, also the marked concentration of sulphate and to a less degree of chloride in the lower soil—4th and 5th feet—would agree with the idea that the gypsum had neutralised most of the carbonate and that drainage has carried the greater part of the salts two or three feet lower down. On the assumption that the land was originally alike at the two places, the decrease of normal carbonate is about 10 tons per acre which is equivalent to about 17·5 tons of gypsum or 14 tons of sodium sulphate; the sodium sulphate in No. 15 is about 16 tons more than in No. 14. How does the quantity of gypsum employed agree with the above? If there has really been a movement of salts such as that above indicated, has it caused the soil to become less permeable to water from 3 feet downwards? Considering how great lateral variation is known to be in these lands, and also that all the information we possess indicates that a downward movement of the sulphate accompanied by a neutralisation of the normal carbonate should tend to coagulate the clay and render it *more* pervious to water, it is much safer to assume, as in the comparison between Nos. 12 and 13, that the two soils were originally not alike and that hence comparison between them is fallacious. So far as one can judge, cultivation in this land tends to keep the salts below; the plot also provides an example of crops growing in such impervious soil. But to what degree the gypsum has affected the land is uncertain.

STATEMENT NO. VII.—*Gursikron Usar. Berings Nos. 14 and 15.*

Depth feet.	No. 14 original land.					No. 15 after treatment with gypsum.				
	Percola- tion cm. per hour.	Salts.				Percola- tion cm. per hour.	Salts			
		Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %		Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %
0— $\frac{1}{2}$	•004	•258	•197	•064	•234	•05	nil	•059	•009	•040
$\frac{1}{2}$ —1	•01	•291	•068	•040	•150	•01	•004	•053	•009	•097
1— $\frac{1}{2}$	•003	•293	•078	•045	•177	•01	•029	•057	•011	•125
$1\frac{1}{2}$ —2	•01	•243	•069	•045	•162	•01	•051	•059	•013	•146
2— $2\frac{1}{2}$	•01	•141	•072	•012	•097	..	•042	•029	•017	•198
$2\frac{1}{2}$ —3	•02	•027	•053	•025	•030	•01	•029	•043	•021	•250
3— $3\frac{1}{2}$	•1	•002	•035	•003	trace	•02	•015	•041	•020	•256
$3\frac{1}{2}$ —4	•15	nil	•038	•005	trace	•03	•005	•041	•021	•271
4— $4\frac{1}{2}$	•15	nil	•033	•003	trace	•05	nil	•036	•025	•204
$4\frac{1}{2}$ —5	•25	nil	•041	•003	trace	•07	nil	•030	•042	•208
5— $5\frac{1}{2}$	•2	•004	•032	•004	trace	•03	•004	•038	•021	•250
$5\frac{1}{2}$ —6	•4	•004	•032	•004	trace	•03	•003	•045	•017	•164
6— $6\frac{1}{2}$	•5	•005	•032	•004	trace	•07	•003	•039	•013	•110
$6\frac{1}{2}$ —7	1•0	nil	•032	•003	trace	•2	•013	•039	•008	•055
7— $7\frac{1}{2}$	1•0	•004	•030	•003	trace	•2	•011	•045	•009	•055
$7\frac{1}{2}$ —8	1•5	•004	•025	•003	trace	•5	•003	039	•003	•021
8— $8\frac{1}{2}$	1•5	•004	•030	•005	trace	•6	•010	•041	•003	•040
$8\frac{1}{2}$ —9	1•0	•004	•027	•004	trace	•6	•003	•038	•003	trace

Salt-bushes.—The land referred to in statement No. VIII is where salt bushes are growing, compared with land close to this cultivation. The four places where the borings were taken are physically very similar, being largely impervious to water to a depth of about 4 ft. from the surface. The usar patch No. 7 contains more normal carbonate in the first two feet than where the barley and salt bushes were growing, but less than the original usar, and the same remark applies to the sulphate and chloride; where the barley was grown these salts were more concentrated in the third foot. The salt bush land is distinctly purer than the others. This land is however of a less objectionable type than most of the places sampled.

STATEMENT NO. VIII.—*Gursikran Usar. Borings near salt bush land.*

Depth feet.	No. 1 Original usar.					No. 7 Usar.					No. 8 Barley crop.					No. 9 Salt bushes.				
	Salts.					Salts.					Salts.					Salts.				
	Percola- tion cm. per hour.	Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %	Percola- tion cm. per hour.	Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %	Percola- tion cm. per hour.	Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %	Percola- tion cm. per hour.	Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %
0—1	·005	·013	·000	·333	·353	·0·4	·093	·036	·089	·095	·01	·019	·000	·030	·037	·008	·017	·088	·020	trace
1—1	·04	·122	·064	·272	·201	·008	·091	·057	·068	·079	·004	·007	·000	·037	·024	·008	·025	·088	·020	trace
1—1½	·01	·120	·076	·351	·384	·01	·084	·036	·095	·107	·008	·089	·053	·061	·043	·01	·003	·067	·013	trace
1½—2	·03	·103	·065	·351	·237	·01	·013	·011	·061	·064	·01	·038	·045	·085	·085	·06	nil	·049	·006	nil
2—2½	·03	·080	·097	·351	·239	·04	·006	·004	·050	·053	·01	·033	·045	·100	·116	·03	·004	·030	·013	·009
2½—3	·03	·053	·050	·312	·180	·05	nil	·039	·029	·014	·03	·009	·011	·036	·110	·03	·004	·043	·008	·009
3—3½	·01	·013	·048	·134	·061	·05	nil	·037	·036	·021	·15	nil	·032	·030	·039	·04	·001	·048	·010	·009
3½—4	·03	·019	·051	·064	·036	·15	nil	·033	·029	·015	·15	nil	·033	·071	·040	·05	nil	·043	·010	·009
4—4½	·1	nil	·037	·011	·009	·20	nil	·030	·013	·013	·25	nil	·026	·055	·018	·05	·002	·042	·007	trace
4½—5	·1	nil	·038	·007	·006	·76	nil	·035	·011	·013	·50	nil	·030	·053	·018	·2	·002	·089	·009	trace
5—5½	1·0	·001	·014	·007	trace	·50	nil	·027	·009	trace	·76	nil	·021	·052	·021	·6	·004	·083	·009	trace
5½—6	1·6	·002	·032	·007	trace	3·5	nil	·025	·011	trace	1·0	nil	·029	·032	·021	1·1	·002	·036	·009	trace
6—6½	·5	·002	·037	·006	trace	3·5	·004	·021	·009	trace	3·0	nil	·023	·018	trace	1·3	nil	·034	·010	trace
6½—7	2·5	nil	·027	·005	trace	2·5	·002	·024	·009	trace	1·7	·009	·031	·018	trace	1·5	nil	·031	·009	trace
7—7½	1·5	nil	·027	·003	trace	2·5	·002	·023	·002	trace	1·3	·002	·025	·016	trace	1·0	·003	·031	·011	trace
7½—8	5·0	·002	·034	·015	trace	4·0	·002	·014	·013	trace	4·0	·004	·019	·013	trace	2·5	·002	·028	·008	trace
8—8½	2·5	·008	·033	·009	trace	3·5	·002	·023	·009	trace	3·0	·001	·021	·017	trace	2·5	·002	·028	·007	trace
8½—9	..	..	..	..	..	2·0	·001	·027	·019	trace	4·0	·002	·022	·011	trace	4·0	·002	·028	·011	trace

The three samples referred to in statement No. IX, were taken purely with a view to future work; since their position is marked on the chart, it will be possible to compare subsequent samples from closely adjacent places with them. It is to be noticed that No. 4 outside the present cultivation is distinctly more saline than Nos. 2 and 3.

STATEMENT No. IX.—*Gursikran Uaar.*
Plot cultivated by Mr. Keventer, 1910.

Depth feet.	No. 3 inside plot.					No. 2 inside plot.					No. 4 outside plot.				
	Salts.					Salts.					Salts.				
	Percolation cm. per hour.	Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %	Percolation cm. per hour.	Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %	Percolation cm. per hour.	Na ₂ CO ₃ %	NaHCO ₃ %	NaCl %	Na ₂ SO ₄ %
0—1	.01	.013	.086	.076	.138	.07	.029	.084	.094	.067	.02	.479	.278	.116	.347
1—1	.004	.135	.055	.057	.009	.02	.145	.021	.040	.083	.01	.469	.095	.077	.265
1—1½	.02	.277	.072	.070	.193	.006	.202	.093	.083	.146	.03	.447	.035	.087	.310
1½—2	.02	.457	.081	.077	.301	.004	.279	.100	.071	.155	.03	.388	.099	.061	.174
2—2½	.01	.467	.102	.093	.323	.04	.209	.092	.066	.103	.01	.292	.102	.065	.116
2½—3	.01	.309	.086	.079	.180	.01	.148	.059	.057	.031	.008	.219	.060	.046	.076
3—3½	.02	.341	.099	.081	.140	.01	.074	.072	.047	.030	.004	.100	.072	.041	.043
3½—4	.01	.181	.062	.058	.085	.02	.028	.054	.084	.031	.006	.097	.073	.024	.012
4—4½	.02	.093	.086	.055	.055	.15	nil	.034	.015	trace	.02	.049	.055	.016	nil
4½—5	.03	.015	.052	.029	trace	.2	nil	.034	.009	trace	.03	.015	.060	.010	nil
5—5½	.2	nil	.027	.021	trace	.2	nil	.032	.006	trace	.1	nil	.045	.009	nil
5½—6	.2	nil	.032	.009	trace	.2	nil	.036	.009	trace	.15	nil	.042	.007	nil
6—6½	.3	nil	.032	.007	trace	.3	nil	.030	.007	nil	.2	nil	.036	.006	nil
6½—7	.3	.003	.021	.005	trace	.3	nil	.033	.007	nil	.2	nil	.036	.006	nil
7—7½	.4	.004	.030	.003	trace	.4	nil	.030	.006	trace	.4	nil	.034	.007	nil
7½—8	.4	nil	.030	.003	nil	.4	nil	.033	.005	nil	.5	nil	.033	.005	nil
8—8½	.6	nil	.039	.003	trace	1.0	nil	.028	.006	nil	1.0	.004	.033	.007	trace
8½—9	1.5	.004	.021	.007	nil	.8	.002	.023	.007	trace	.7	nil	.033	.006	trace

Conclusions.

(i) The only experiment which can claim to have really reclaimed the usar land is the application of gypsum. The cost of sufficient gypsum to effect this was very great—about Rs. 700 or Rs. 800 per acre—and is obviously prohibitive. Even if the cost of gypsum could be reduced to one-half (what was employed cost about Rs. 20 per ton) it would still be too expensive if required in the quantity that this land did require it. At the same time the land selected was some of the very worst usar and there are many large areas which would not require more than about $\frac{1}{4}$ or $\frac{1}{2}$ so much; in such cases the employment of this material comes more nearly within the range of financial possibility.

(ii) The effect of deep and good cultivation coupled with heavy manuring has not been either what is indicated to the unaided eye nor what might have been anticipated. The surface foot of soil has been apparently reclaimed, but below this the soil is as bad as ever.

(iii) Scraping off the salts is practically useless.

(iv) There are two suggestions for future work which are worth considering though neither may have any practical value.

(a) The one, due I think to Mr. Moreland, is to dig out the impervious top soil. The soil below this is freely permeable and might become, after cultivation, perfectly good soil. The cost of digging it out might readily be excessive, but rough calculations show that it *might* pay to remove an impervious bed if this were not more than 4 feet thick. We don't know very much about these beds at the present time, but the land where the salt-bushes are growing is a case in point.

(b) In my first memorandum (para. 36) I went into some rough calculations relative to the time required for water to percolate through these beds on the assumption that about 2 feet of water would be maintained on the land. This calculation showed that some months and possibly years would be necessary. Supposing this to be carried out, most of the salts would be thereby removed to at least a lower stratum. It might also *then* prove not too expensive to use a small amount of gypsum to improve the physical state of the soil. To maintain water thus on the land would not be expensive, the point of chief importance being the up-keep of the bunds.

Report III.—The nature of certain Alkali Patches situated in the Muttra and Etah Districts, by Dr. J. W. Leather, Imperial Agricultural Chemist, March 1912.

Contents.

Introductory.	The permeability of the Soils.
Tours.	The Salts.
Method of taking Soil specimens.	Sulphate.
Number of Usar patches examined.	Sodium chloride.
Condition of Crops.	The bi-carbonate.
Sterility of the selected patches.	The normal carbonate.
Amount of Kankar present.	Relative effects of salts and imper-
Tests employed.	viousness.
Review of information obtained.	Effect of water-logging.
	Conclusions.

Appendix I, Details of laboratory methods employed.

Appendix II, Analytical data regarding each of the 67 Usar patches.

Introductory.—In 1909, I was asked by Mr. B. C. Burt, Deputy Director of Agriculture, to assist him in the investigation of some land near Bhadan in the Mainpuri District which is under irrigation from the Bhognipur branch, Lower Ganges canal, where complaint had been made that there had been a recent extension of *usar*. A long series of tests were made in relation to this *usar* land, and my report on them was submitted with letter no. 385/I-2, dated the 3rd September 1910 (first paper of this series). One question which arose as a consequence of this work was in how far does the nature of the *usar* patch situated in arable land which is under well-irrigation differ from the similar patch which occurs in land under canal irrigation? It cannot be too clearly kept in mind that this question is not necessarily related to any rise in the water level of an agricultural tract subsequent to the introduction of a canal; the two features may or may not be related. Again, the further question whether such *usar* patches become worse subsequent to the introduction of the canal is one which is distinct and could only be decided by making a comparison of certain such *usar* patches before and after the introduction of canal irrigation.

The matter was discussed at Naini Tal by Messrs. Moreland, Hutton, Bull and myself and it was decided to select two neighbouring tracts of country as similar as possible, the one under well-irrigation, the other under canal-irrigation, in each of which *usar* patches occurred in the fields; to then take samples of the soil of such patches from the surface to a number of feet deep, and to apply to these samples of soil such laboratory tests as would demonstrate their principal characteristics in relation to their "alkali" nature.

The line of country visited in order to find two such tracts was from the Jalesar Road Station, East Indian Railway to Awa Khas, a distance of about 20 miles. The first 10 miles from Jalesar Road Station to Jalesar included land entirely under well-irrigation; the second 10 miles, land which has been under canal-irrigation from the Etawah branch for a long series of years. In both areas the cultivated lands contain the characteristic *usar* patches. This stretch of country therefore fulfilled a first condition, namely neighbouring tracts of land under well and under canal-irrigation respectively and containing *usar* patches in the fields. But fortunately it fulfilled a second condition, for the new Hathras branch will irrigate the land in the Sadabad and Jalesar Tahsils which is at present under well-irrigation, and thus a future comparison of selected *usar* patches in this area, with their present state would go far towards a dependable decision as to whether canal irrigation really does cause an extension of such patches, for, as I have explained in my report (covering letter no. 385/I-2

dated the 3rd September 1910) there is no really reliable evidence at present admitting of a conclusion on the point.

It is perhaps well to emphasise here that the comparative analysis of these *usar* patches has nothing to do with their relative number in the two areas, much less is it an estimate of the total area of *usar*. But since I have toured through the tract twice it may be well to express a general opinion formed by an eye estimate on the subject.

As regards the total area of *usar* in the two tracts, there can be no doubt that the canal-irrigated area includes a much larger one than the well-irrigated. In the former are extensive *usar* plains, in the latter such plains are very much smaller. At the same time such *usar* areas do exist in the neighbourhood of most of the villages of the well irrigated tract. As regards the relative frequency of the *usar* patch in cultivated fields the eye estimate would be liable to serious fault. In some villages they seemed to be quite as frequent as, if not more so than, in the canal-irrigated area; in other villages they are practically or wholly absent.

Tours.—I inspected this stretch of country in company with Mr. Athim in November 1910 and noted villages in which *usar* patches occurred. Arrangements were then made (i) by Mr. Athim for the charting of the patches, and (ii) by myself for taking the samples. In February and March 1911, I again visited the area, when the long series of samples was taken.

Method of taking the soil specimens.—For the purpose of taking the samples I utilised the method described in Memoir of the Imperial Department of Agriculture, Chemical Series, Volume I, No. 6, page 84, and No. 10, page 234. In order to cut through the kankar found in these *usar* soils, a somewhat stronger cylinder was necessary but otherwise the tool answered the purpose well. Three assistants of this chemical laboratory were employed to take the samples and this work was done during February and March 1911. All the *usar* patches were selected by myself. They were marked by flags and the assistants visited the fields in question and took the samples on the day following the selection of the patches.

Number of usar patches examined.—The number of *usar* patches examined was, 29 in the tract under well-irrigation and 29 in the canal-irrigated tract.

The specimens of soils were taken out in 6" sections, usually to a depth of 9 feet, thus making 18 soil specimens from each patch. An examination of these enables one to ascertain the properties of the soil in each succeeding 6" stratum and to show very clearly how deep the *usar* soil is.

Altogether upwards of 1,200 such specimens have been examined and this will explain the delay in submitting the report.

In addition to the examination of the soil of the selected *usar* patches, it was decided to examine the good soil closely contiguous to certain of the *usar* patches situated in the neighbourhood of the Hathras branch. Supposing at a future time these patches are said to have extended subsequent to the introduction of canal irrigation, it would prove a great advantage, if one were able to refer to a certain spot in a field with the knowledge that at a time immediately prior to canal-irrigation the soil had been fertile and possessed of certain well defined characteristics. It would have amplified the work too much to have tested both the fertile and the infertile soil of all the 29 selected fields, and therefore only nine such comparative tests were made. The fields selected were in the villages Makatpur, Bichpuri, and Unchagaon and close to the canal. It is here where a rise in the subsoil water level may be first anticipated and therefore, if an extension of *usar* is related to this rise, it may be expected that such an extension will occur earliest in such fields.

Before describing the tests to which the specimens of soils have been put, reference may be made to the general fertility of the selected fields and the apparent sterility of the *usar* patches; both of these features were only measurable by the eye but the comparisons are useful.

Condition of crop in the major part of the selected fields.—The tabulated data obtained from the laboratory examination of the specimens includes notes on the character of the crop surrounding each patch, so that for details regarding these

to illustrate the chief points and to render deductions from this test easy, the data regarding the permeability of the soil of three borings are collected together in the following statement :—

Boring Village: Field.	I Makanpur 534—6	XI Makanpur 217—8.	LXVII Bichpuri 48J.
Depth.	cm. per hour.	cm. per hour.	cm. per hour.
0"—6"	·021	·031	·26
6"—1' 0"	·003	·016	·74
1' 0"—1' 6"	·016	·004	·43
1' 6"—2' 0"	·012	·005	·69
2' 0"—2' 6"	·003	·016	·69
2' 6"—3' 0"	·003	·004	·62
3' 0"—3' 6"	·003	·016	·66
3' 6"—4' 0"	·016	·003	·63
4' 0"—4' 6"	·010	·016	·83
4' 6"—5' 0"	·031	·025	·33
5' 0"—5' 6"	·023	·019	·49
5' 6"—6' 0"	·021	·041	·98
6' 0"—6' 6"	·015	·20	·81
6' 6"—7' 0"	·083	1·25	·39
7' 0"—7' 6"	·031	·29	·23
7' 6"—8' 0"	·033	·40	..
8' 0"—8' 6"	·018	1·48	..
8' 6"—9' 0"	·014	..	..

A glance over the tests of the soil specimens of the first *usar* patch (village Makanpur, field 534—6) shows rates of percolation as low as ·003 cm. per hour, and as high as ·083 cm. per hour. The latter is obviously exceptionally high among the series, but several of them approximate to ·04 cm. Turning to Boring No. XI (village Makanpur, field 217—8) the variations were found to be from ·005 to ·02 cm. per hour in the upper 5' 6" of soil. At present there is no object in considering the causes of such variations; they are partly due to experimental error but principally to actual variation in the physical state of the soil. Turning now to the lowest 2' 6" of soil in the same boring (village Makanpur field 217—8) it is seen that the rate of percolation lies between the limits ·20 cm. and 1·48 cm. per hour. Or again, in the soil of Boring LXVII (village Bichpuri, field 48J) the variations lie between ·25 and ·98. These instances exemplify very well what variations may be found among a series of soil specimens lying, as these do at different depths, and they also illustrate the difference in rate of percolation which occurs among soils of different physical character. For evidently there is a very marked difference between the soil (for example) of the upper 5' 6" and the soil between 6' and 8' 6" of the *usar* patch No. XI (village Makanpur, field 217—8): or similarly, despite the variation in rate of percolation among individuals of the series of specimens of soil from Boring No. I (village Makanpur, field 534—6) or among the series from Boring LXVII (village Bichpuri, field 48J) a glance at the two columns of figures shows that the nature of the soil is quite different, the one from the other. It is indeed quite easy to distinguish the highly impervious *usar* soil from the permeable good soil: the rate of percolation in the former may be said always to be less, generally very much less, than ·1 cm. per hour whilst that of the latter will be usually considerably greater than ·1 cm. In order to

extension of the contiguous *usar* patch, the shape of which appears to vary very considerably.

Summing up the evidence in respect of this feature of the soil, it must be concluded that the soil of these *usar* patches is substantially identical, whatever the system of irrigation employed and whether the sub-soil water level is high or otherwise.

The salts.—As explained in the appendix No. 1, the chemist is practically obliged to calculate the whole of the chloride, the sulphate, and the carbonates found in these *usar* soils as the sodium salts, and though such is doubtless not entirely the case, there is no doubt that in these United Provinces' *usar* soils the greater part does consist of the sodium salts.

It has been explained that it was considered sufficient to test every alternate 6" portion in respect of salts.

The sulphate.—The quantity of sulphate present was in most cases nominal, and may be thus set out :—

Quantity.		Number of cases.	
		Well-irrigated.	Canal-irrigated.
Very small	..	23	24
·03—·1 %	..	4	4
>·1 %	..	..	1

It is in any case a comparatively harmless salt when present in quantity less than ·1 per cent.

Sodium chloride.—The amount of sodium chloride does not vary so much as do the sulphate or normal carbonate; it is present in measurable, though small, quantity in all the soils, and in rather greater quantity in the most impervious strata than in the soil below. The following condensed statement of the average quantity found in the most impervious strata will best exhibit the amounts :—

NaCl per cent.			Number of cases.	
			Well-irrigated.	Canal-irrigated.
·01	..	..	5	17
·02	..	..	10	7
·03	..	..	5	4
·04	..	..	1	1
·05	..	..	1	..
·06	..	..	1	..
·07	..	..	3	..

Thus on the average the "canal irrigated" soils contained somewhat less than those under well-irrigation. The amount is not sufficient in itself to affect vegetation seriously. Among the nine fertile soils which were examined, two contained amounts greater than ·01 but in the remainder the percentage was considerably below this figure.

The bi-carbonate.—This salt is present in all the soils both good and bad. The latter contained from two to three times as much as the former. No doubt a part was present as the calcium salt which is present in all fertile soils, and if this could be differentiated from the sodium salt, the difference in the amounts of the latter in good and bad soils respectively would be found greater than the figures indicate. Practically nothing is known of its effect on vegetation.

The normal carbonate.—This is the salt which is unquestionably the most harmful and its amount in the series of soil borings deserves a close scrutiny. Confining the attention to the soil of the *usar* patches, it was present in all the *usar* soil throughout the impervious stratum and is frequently present also in the permeable soil underlying the impervious. Its quantity varies a good deal but usually ranges from about .06 to .09 per cent. In order to compare the amounts in the soil of the two series of *usar* patches, averages have been taken of its amount in the most highly impervious soil and these are set out in the following statement :—

Average percentage Na_2CO_3 .	Number of cases.	
	Well-irrigated.	Canal-irrigated.
.01	1	..
.03 .. ..	..	1
.04	2	1
.05	2	1
.05	5	2
.07	5	2
.08	5	3
.09	2	5
.10	2	2
.11	2	2
.12 .. ..	..	2
.14	1	..
.17 .. ..	..	1
.18 .. ..	..	1
.19	1	..
<.05	5	3
.06—.09	18	18
>.09	6	8

Thus in each area the majority of the soils contained the same average quantity of sodium carbonate. Looked at as a whole the conclusion may be drawn that the *usar* soil of the patches in the canal-irrigated area contained rather more carbonate than that of the well-irrigated, but the difference is only small. Turning to the nine cases in which the adjacent fertile soil was also tested, it is not possible to average the figures readily since they vary so much. The fertile soil contained, in three cases, no measurable amount of sodium carbonate throughout the nine feet of soil examined; in the other six cases the surface soil was free, but the sub-soil contained small amounts of this salt commencing at a distance of 3 feet to 6 feet from the surface, which though less than in the adjacent *usar* were in some cases greater than .05 per cent.

In conclusion as regards the *alkali* salts, it is to be noted that these are not principally concentrated in the surface soil; it is quite common to find the greatest concentration some feet distance from the surface. As explained in the memorandum submitted with my letter no. 385/I-2, dated 3rd September 1910, if a soil is so highly impervious to water as these soils are, the amount of water which moves towards the surface during dry weather must be necessarily small, and it is consequently not possible for the salts to move very much; hence a general concentration of salts in the surface soil is not to be expected.

The relative effect of salts and of imperviousness on the growth of plants.—During the last two years potcultures were made at Pusa, in which *usar* soil from Sarajpur, near Bhadan was employed, the objects in view being to ascertain (a) the effect of different manures on the fertility of the soil, (b) the effect of the sodium

carbonate on plants as distinct from the imperviousness and (c) the effect of the imperviousness on plants as distinct from the *alkali*.

The analysis of the soil showed that it contained sodium carbonate .063 per cent. and sodium bi-carbonate .078 per cent. with only traces of chloride and sulphate. The rate of percolation was :—

						Percolation. cm. per hour.
0'—6" ..	..	..	..	..	..	.09
6"—1' 0"	..	..	..	..	..	.007
1'—1' 6"	..	..	..	..	..	.008
1' 6"—2' 0"	..	..	..	..	..	.005

In respect of (a) it will be sufficient to say that none of the manures had any really beneficial effect.

Regarding sections (b) and (c) the results were interesting. The method of testing these two questions was as follows. If gypsum be added to *usar* soil, it reacts with the sodium carbonate, producing sodium sulphate; the amount of carbonate changed being equivalent to the amount of gypsum employed. If the gypsum used is in excess of the sodium carbonate, the physical state of the soil is also altered, in that the deflocculated clay becomes coagulated, rendering the soil quite permeable to water. But if less gypsum be added than is required to change all the carbonate into sulphate, the physical state of the soil remains apparently unchanged; that is, by regulating the amount of gypsum, the *alkali* may be reduced to quite small dimensions without improving the physical state. If soil is treated in this manner with varying proportions of gypsum and plants are subsequently sown in it, there should be, in so far as *alkali* is concerned, an improved growth corresponding to the reduced amount of *alkali*. If on the other hand the *alkali* had but little effect on the plant, but the impervious state had a great effect, then such limited treatment with gypsum would not improve the fertility. At the same time such an experiment would not completely differentiate between these two factors. Another series was therefore arranged in which the physical defect of the soil was removed by means of sodium chloride whilst leaving the sodium carbonate intact. Sodium chloride, like most salts, if present in sufficient concentration, coagulates the clay and makes the soil quite freely permeable to water. At the same time this experiment naturally raised the question as to whether the sodium chloride used would itself adversely affect plant growth, and necessitated a third series of tests in which the effect of sodium chloride on plants was tested in an otherwise fertile soil. In considering the results of these several experiments it will be most convenient to consider the last named first. It was known that if .1 part sodium chloride were added per 100 parts of the dry soil and water also added, the clay would become completely coagulated, and that less than half this quantity would partially improve the physical state. Accordingly in the experiments in which sodium chloride was employed the following proportions .25 per cent., .1 per cent., .05 and .025 per cent. sodium chloride were mixed with the soil, which was filled into cultivation jars and water added. A little sodium nitrate was added to act as a stimulant. In the series of tests in an otherwise good soil, the plants grew quite well in all cases except where the proportion of sodium chloride was so high as .25 per cent., as is demonstrated by the photograph (p. 21) and the following harvest figures :—

Pusa soil plus varying amounts of sodium chloride.

				Proportion of sodium chloride in soil.				
				None.	.025 per cent.	.05 per cent.	.1 per cent.	.25 per cent.
				Weights of plants at harvest (grms.)				
Maize ..	..	..	..	19.6	30.2	14.7	20.2	8.0
Marwa ..	..	..	..	19.5	29.7	14.7	15.6	NIL.
Rice ..	..	..	..	30.8	45.6	29.6	29.7	.4
Sunn Hemp ..	..	..	..	56.2	80.8	45.1	33.8	29.2

A comparison of these weights shows that whilst .25 per cent. of sodium chloride in the soil seriously affects the growth of most plants, .1 per cent. usually does little harm. If therefore not more than this proportion is added to an *alkali* soil like that from Surajpur any imperfect growth of plants in the soil could not be attributed to the salt. If further this amount of the salt is sufficient to materially improve the permeability of the soil to water, any improved plant growth may reasonably be attributed to the improved physical state of the soil.

The results of sowings in the two series of soils, namely in those to which gypsum or sodium chloride respectively was added, may now be stated.

Surajpur near soil plus gypsum.

		Proportion of gypsum used expressed as a fractional equivalent of the sodium carbonate in the soil.							
		Nil.		1		2		3	
		Germinated.	Matured.	Germinated.	Matured.	Germinated.	Matured.	Germinated.	Matured.
<i>Monsoon crops.</i>									
Just 5 seeds sown .. .. .	..	1	0	0	0	1	0	1	0
Fajra .. .. .	..	1	0	4	0	2	0	2	1
Urid .. .. .	..	0	0	3	0	0	0	5	1
Math .. .. .	..	0	0	0	0	0	0	1	0
Guar .. .. .	..	0	0	0	0	1	0	2	2
Val .. .. .	..	0	0	2	0	0	0	3	0
Rice 15 seeds sown .. .. .	..	1	1	7	7	13	12	11	10
Kodo .. .. .	..	1	0	0	0	0	0	0	0
Karni .. .. .	..	2	0	0	0	0	0	0	0
<i>Cold weather crops.</i>									
Wheat 50 seeds sown .. .. .	..	12	7	15	6	20	6	0	0
Barley 5 seeds sown .. .. .	..	2	0	5	0	4	0	4	0
Oats .. .. .	..	0	0	1	1	0	0	0	0
Lentil .. .. .	..	0	0	0	0	0	0	0	0
Khesari .. .. .	..	0	0	4	0	0	0	4	1
Gram .. .. .	..	0	0	0	0	0	0	2	0
Peas .. .. .	..	0	0	4	0	0	0	4	2
Boy bean .. .. .	..	0	0	0	0	0	0	0	0
Barson 10 seeds sown .. .. .	..	0	0	0	0	0	0	0	0
Toria .. .. .	..	0	0	0	0	0	0	0	0
Linseed .. .. .	..	0	0	0	0	5	5	5	5
Safflower .. .. .	..	0	0	1	0	5	5	5	5

Surajpur soil plus sodium chloride.

		Proportion of sodium chloride in soil.							
		Nil.		.025%		.05%		.1%	
		Germinated.	Matured.	Germinated.	Matured.	Germinated.	Matured.	Germinated.	Matured.
<i>Monsoon crops.</i>									
Just 5 seeds sown .. .. .	..	1	0	..	..	..	..	..	..
Fajra .. .. .	..	1	0	..	..	..	..	..	..
Urid .. .. .	..	0	0	..	..	..	..	..	..
Math .. .. .	..	0	0	..	..	..	..	..	..
Guar .. .. .	..	0	0	1	0	..	..	..	..
Val .. .. .	..	1	1	..	..	..	..	..	..
Rice 15 seeds sown .. .. .	..	1	0	..	..	..	..	..	..
Kodo 5 seeds sown .. .. .	..	2	0	..	..	..	..	..	..
Karni .. .. .	..	..	..	..	..	..	..	..	..
<i>Cold weather crops.</i>									
Wheat 20 seeds sown .. .. .	..	12	7	1	0	16	0	18	0
Barley 5 seeds sown .. .. .	..	2	0	..	..	..	..	8	0
Oats .. .. .	..	0	0	..	..	..	..	0	0
Lentil .. .. .	..	0	0	1	0	..	..	0	0
Khesari .. .. .	..	0	0	..	..	..	..	..	..
Gram .. .. .	..	0	0	1	0	..	..	..	..
Peas .. .. .	..	0	0	..	..	..	..	..	..
Boy bean .. .. .	..	0	0	..	..	..	..	..	..
Barson 10 seeds sown .. .. .	..	0	0	..	..	..	..	..	..
Toria .. .. .	..	0	0	..	..	..	..	..	..
Linseed .. .. .	..	0	0	..	..	..	..	..	..
Safflower .. .. .	..	0	0	..	..	..	..	..	..

Neither of the treatments resulted in great fertility and the best of the plants produced were comparatively small; moreover, the germination was, in many cases zero, and of the germinated seedlings a large proportion died again. But as a test of the question whether the *alkali* in the soil, or the imperfect physical state of the soil has the greater influence on vegetation the answer seems to be definite, for, there were, after all, a good many plants which matured in the soil after addition of gypsum whilst not a single plant survived in the soil treated with salt; that is, by reducing the *alkali* sufficiently the soil is enabled to support some growth, whereas by merely making the soil more pervious to water but leaving the *alkali* intact, no increased fertility resulted. The tests were not without defect and exhibited several marked erraticisms. For example, among the wheats, which included four varieties, the untreated soil produced an unexpected number of plants, whilst the jars of soil to which most gypsum had been added produced none at all. But this seems to be rather characteristic of cultivations in *alkali* soils; here and there growth succeeds in an unexpected manner. Then, too the amount of sodium carbonate remaining in the soil to which the two larger proportions of gypsum ($\frac{1}{2}$ and $\frac{3}{4}$) had been added was only about .015 per cent. and there are not a few examples in the literature as also in my experience of very good growth in the presence of so little *alkali*, and yet in our experimental case the reduction of the *alkali* from .06 per cent. to .015 per cent. had no very striking effect on the plant growth. A reference to the use of the smallest proportion of sodium chloride is also interesting. This quantity, .025 per cent., had the effect in the Pusa soil, of very considerably increasing the growth of all the plants, the improvement being equal to about 50 per cent. of the untreated soil; but its addition to the *usar* soil in small quantity had no better influence than in large quantity.

The effect of water-logging.—Two years ago when the soils near Bhadan were being investigated the question was raised whether the rise of sub-soil water level, which had occurred in that tract, had created the *alkali* spots or had increased the area of such spots already in existence.

It seemed reasonable, in order to experiment on the matter, to assume that the soil which would be most likely to be affected would be that which was lying close to an *alkali* spot, but which was still quite good. Accordingly some good soil from the fields in villages Surajpur and Galpura in which these *alkali* spots were situated which were then the subject of experiment, was sent to Pusa. In each case the soil selected was closely contiguous to the *usar* patch but was bearing a crop; the one at Surajpur was arhar and this soil is designated S. A., whilst that at Galpura had a crop of *juar* and arhar and is accordingly distinguished as G. J. A.

These two soils were taken out of the field in 6" layers down to a depth of 2' 0".

At Pusa the soils were packed into cultivation jars (for description see page 40 of Memoir No. 3, volume 1, Chemical Series) each 6" being placed in its proper relative position; a glass tube extending from above the surface to the bottom was inserted at the time of filling for the purpose of adding water. A bed of 2" of clean sand was also filled in below the soil in order to allow the free circulation of added water to the lower surface of the soil.

These two jars of soil have been maintained with a *mean* content of water equal to 20 per cent.; though the lower soil has been naturally wetter and the upper soil drier than this; the jars have been weighed weekly and the evaporated water replaced by addition through the glass tube to the sand bed below. The daily loss of water from the surface has varied, having always been greater from S. A. than from G. J. A. and there has been a gradual decline in the quantity over the period. From G. J. A. the evaporation may be stated as varying from about .07 to .14 cm. per day according to the weather and season, that from S. A. as .14 to .28 cm. The *decline in rate of evaporation* may be stated as having been for S. A. from 1 unit to about $\frac{2}{3}$; for G. J. A. from 1 unit down to about $\frac{1}{2}$ unit. On 2nd April 1912 samples of these two jars of soil were taken in the same manner as in the field,

except that every 3" instead of every 6" was separately examined, and the specimens tested for alkali and permeability. The results of this examination are set out in the subjoined statement.

Depth.	S. A.				G. J. A.			
	Percolation test.		Alkali 1912.		Percolation test.		Alkali 1912.	
	cm. per hour.		Sodium carbonate.	Sodium bi-carbonate.	cm. per hour.		Sodium carbonate.	Sodium bi-carbonate.
	1910.	1912.			1910.	1912.		
0"-3" ..	-5	-6		-015	1.5	-07		-018
3"-6" ..		-25		-015		-06		-021
6"-9" ..	-6	-6		-018	1.2	-02		-027
9"-12" ..		-6		-021		-02		-030
12"-15" ..	-6	-7	Nil.	-041	.4	-01	Nil.	-033
12"-15" ..		-6		-018		-2		-024
15"-21" ..	-5	-6		-024	.01	-4		-024
21"-21" ..		..		..		..		..

Of the two, the Surajpur soil has obviously not suffered any perceptible change. The Galpara soil however seems to have suffered some change physically, the lower 6" appears to have been improved whilst that above has suffered by the treatment. In neither case has any sodium carbonate been formed and the amount of bi-carbonate is small and does not indicate the formation of "alkali." No definite conclusion can be drawn from the experiment except that it indicates the possibility of certain soils suffering from a high water level. However, if the areas of the *usar* patches in the Hathras branch area, which have been detailed in this report, are carefully recorded, a definite answer to the question as to the effect of water-logging may be anticipated.

If desired some further tests like those above referred to might be also arranged for, but in order to secure a definite result, a very considerable number of such tests should be made, because it is to be recollected that in any case it is not every soil which will become *usar* from water-logging, but only certain soils, and since there are no means of distinguishing the latter from the former, it becomes necessary to apply the test to a considerable number of "likely" soils in order to have a fair chance of including a few that would become affected if indeed water-logging does actually affect any soils in this manner.

Conclusions.

The conclusions which may be drawn from the investigation into the characteristics of the *usar* patches in the two areas may be thus stated:—

- In respect of frequency, infertility, nature and amount of salts, or physical condition, there is substantially no difference between the soil of the *usar* patch which has been under canal-irrigation for many years and that which has never been subject to this influence at all.
- The patches are in reality the exposed surface of a block of "alkali" soil of irregular shape and commonly 7, 8, 9 or more feet deep. There is usually between .06 and .09 % sodium carbonate present together with unimportant amounts of chloride and sulphate. The soil is always highly impervious to water.
- As a consequence of the latter characteristic, the amount of water which can annually drain downwards through these soils or which moves upwards towards the surface and evaporate during dry weather is neces-

sarily very small. It also follows that no large proportion of the salts can either drain away downwards during wet weather or rise to the surface during dry weather. In respect of this matter reference should be made to my first memorandum on the soils at Bhadan.

- (d) It is very desirable that these *usar* patches should be tested again after the Hathras branch has been in use for some years. Hitherto investigations on *usar* have been limited to chemical analyses and field trials for improvement, the latter having proved practically a failure. But until fixed spots are tested before and after the introduction of canal irrigation, it will not be possible to provide a definite answer to the question as to whether canal irrigation does or does not occasion an increase in them. All that can be said at present is that these *usar* patches are precisely similar whatever the mode of cultivation or irrigation employed.
- (e) Tests made at Pusa over a period of two years give some indication that certain classes of soil may become less pervious to water if maintained in a constantly water-logged state, but the evidence is only slight and would require substantiation before such a change can be assumed to be certain.
- (f) The sterility of the soil is due in part to the sodium carbonate and in part to its bad physical state; removal of the *alkali* alone would not render it fertile.

APPENDIX I.

Method employed for the determination of sodium salts in the soils.

100 grms. of the air-dry sample was digested, with periodical hand shaking, in 500 c.c. of recently boiled distilled water, at room temperature for approximately one hour, then allowed to stand over night. On the following morning without further agitation the muddy water was poured into a Houston pressure filter. Each filter was, immediately prior to being used, washed by forcing 500 c.c. distilled water through the "candle." The pressure in the filters was maintained at about 40–50 lbs. per sq. in. Of the soil extract, the first 100 c.c. which came from the filter was discarded, and the analysis made in the subsequent portion. This mode of dealing with the soil extract was adopted after tests had been made by the late Babu Subodh Chandra Kar at Mr. Burt's suggestion, at Bhadan in 1910.

The following determinations are made in the extract:—

- (i) 100 c.c. was titrated with standard sulphuric acid using phenol phthalein as indicator and the result calculated to Na_2CO_3 .
- (ii) After addition of methyl orange to the same portion, the extract was titrated with the same standard acid and the result, minus the first quantity, calculated to NaHCO_3 .
- (iii) 50 c.c. was titrated with silver nitrate for chloride.
- (iv) 100 c.c. was very slightly acidified with hydrochloric acid, a few drops of barium chloride solution added and kept on a warm sand bath near the boiling point for about 1 hour after which any barium sulphate which had formed was filtered off.

Method of measuring the permeability of the soil to water.

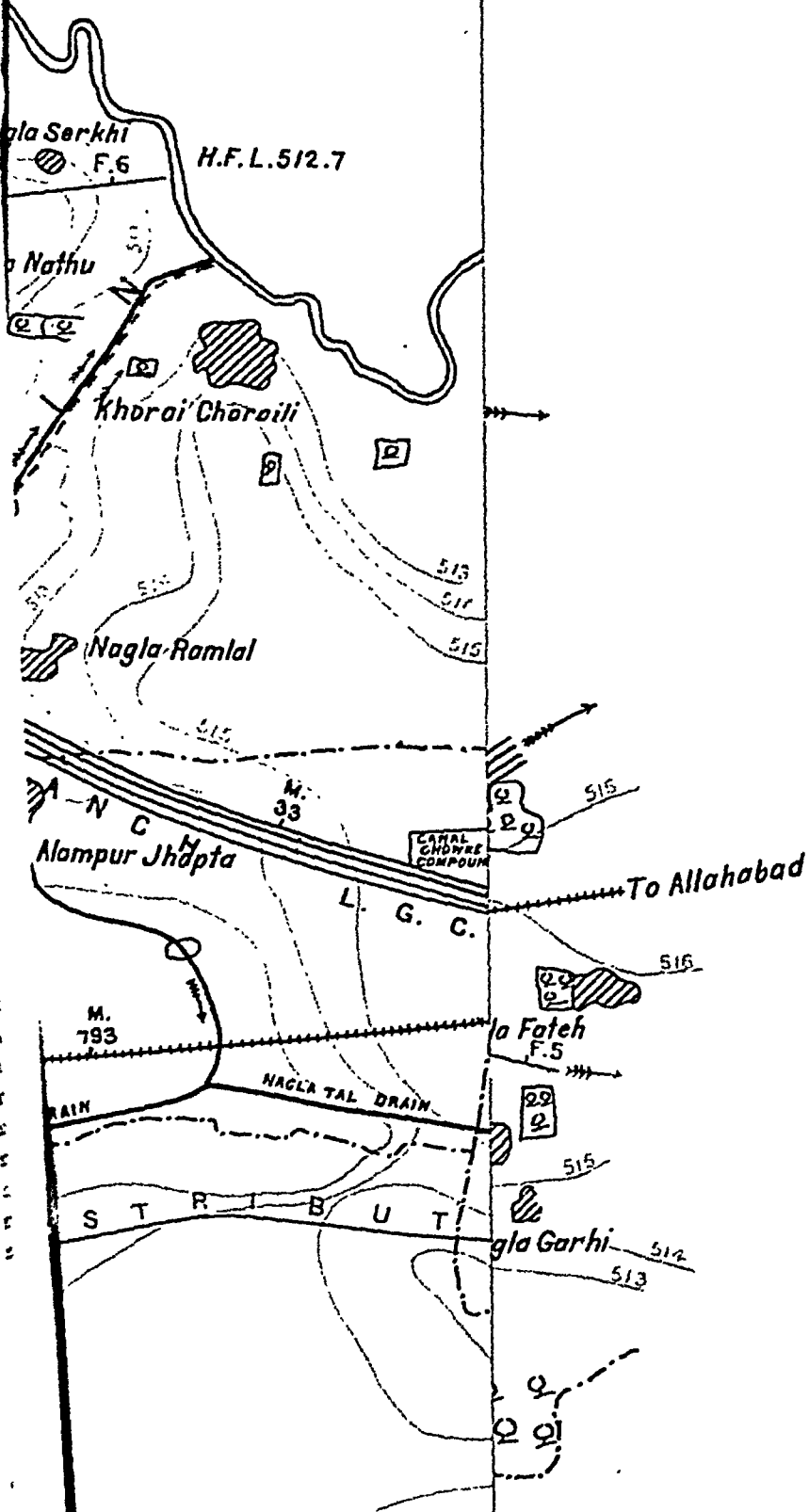
The method used to determine the rate at which water percolates through soils, or the permeability of the soil to water, is a purely empirical one and was devised especially for the examination of these *usar* soils. It consists in packing the soil, in a slightly moist condition, by means of the machine subsequently described, into metal cylinders, the bottom of which consists of wire gauze; distilled water is then poured on to the upper surface of the soil, and, after it has commenced to percolate from the bottom, the rate at which it is percolating is deduced from the volume of water which passes through in a known time.

The soil packing machine is illustrated by the accompanying two photographs, taken from opposite sides of it. It will be seen that there are two rods marked K.

CONTENTS.

	Page.
REPORT I.—THE NATURE OF INFERTILE LAND NEAR BHADAN	1—23
The amount of water in the soil	2
The vertical and lateral variation	3
The seasonal variation	3
The salts in the soil	6
The vertical and lateral variation	8, 12
The seasonal variation	9, 12
The rate of water movement	13
Juhi usar soil	17
Sterile patches in non-canal irrigated villages near Bhadan	18
Possible effect of canal water	20
The drainage water	22
Conclusions in respect of the land near Bhadan	22
REPORT II.—THE EXPERIMENTS AT ALIGARH	24—37
Effect of heavy manuring and cultivation	25
Scrapping off the salts	27
Effect of gypsum	29
Growth of salt-bushes	33
Conclusions in respect of the Experiments at Aligarh	37
REPORT III.—NATURE OF ALKALI PATCHES OF LAND UNDER WELL AND CANAL-IRRIGATION IN MUTTRA AND ETAH DISTRICTS	38
Method of taking soil specimens	39
Number of patches examined	39
Condition of the crops	40
Sterility of the selected patches	40
Tests employed	41
The permeability of the soils	42
The salts	44
Effect of salts and of imperviousness on the growth of plants	46
Effect on soils of water-logging	48
Conclusions in respect of usar patches of land under well and canal irrigation	50
Methods of analysis employed	50
Method of determining the permeability of soils to water	51
List of usar patches examined	53
Statements and charts [... .. .	55

BHOAL.



PREFACE.

The three reports which are published in this volume contain the results of investigations into the character of certain classes of "usar" or "alkali" land in the United Provinces. The initial subject, namely the usar land in villages on the Bhognipur branch of the Lower Ganges Canal, was brought to my notice by Mr. B. C. Burt, Deputy Director of Agriculture, and the subsequent investigations were the outcome of it.

I desire to take this opportunity of expressing my obligations to Mr. Burt, with whom I had the privilege of collaborating so closely in the initial investigations, to Dr. A. E. Parr, Deputy Director of Agriculture, and to Messrs. Athim and Hall, the Executive Engineers of the irrigation area in the Muttra and Etah Districts, which became the subject of the third report, and who had the charts of the individual usar patches prepared.

AGRICULTURAL RESEARCH
INSTITUTE, PUSA:
The 3rd October 1912.

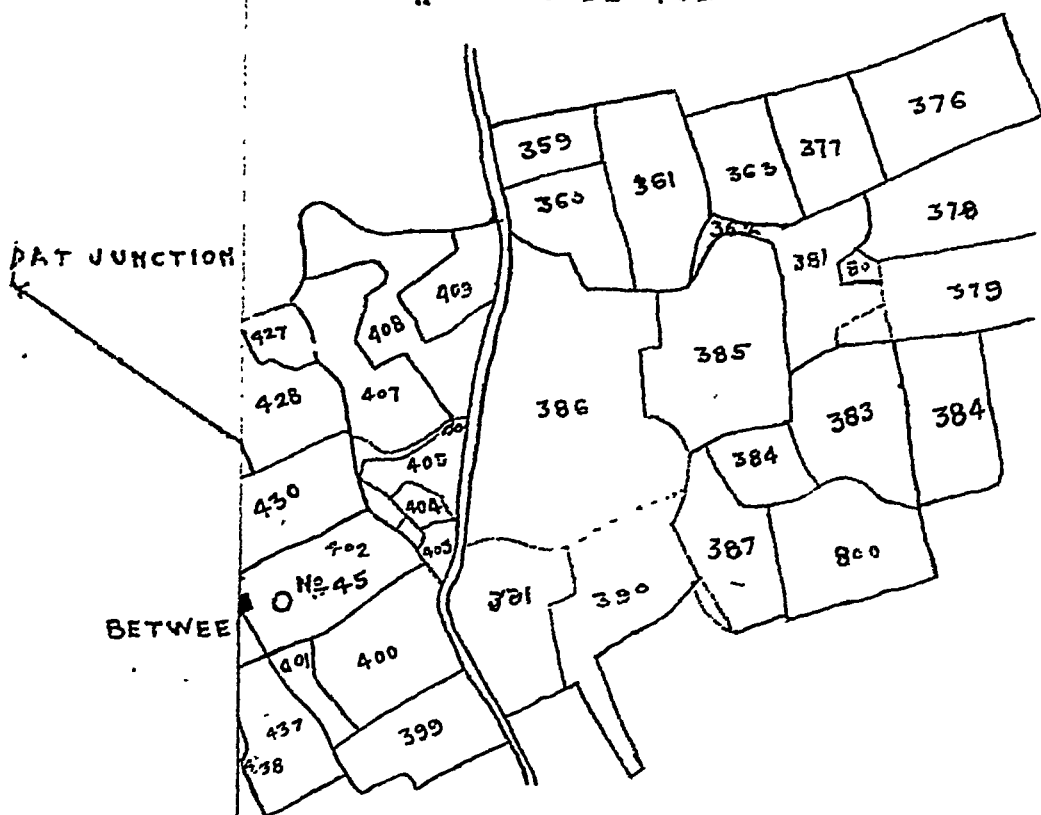
J. WALTER LEATHER.

N^o OF FIELD

CROP BARLEY

N^o OF BORING 4-5

N^o OF FIELD 402



(SD). KANHAIYA LAL,

EXECUTIVE ENGINEER,

ALIGARH DN., GANGES CANAL.

29-4-13.

RE,

S. O.

STATEMENT C.

Details of expenditure of the Locomotive and Carriage Superintendents' Committee disbursed by the Bombay, Baroda and Central India Railway for the financial year 1923-24.

Items.	Half-year ending 30th September 1923.	Half-year ending 31st March 1924.	Total for financial year 1923-24.
	Rs. A. P.	Rs. A. P.	Rs. A. P.
Secretary's salary and allowance	1,200 0 0	1,334 0 0	2,534 0 0
Clerks' salaries	720 0 0	720 0 0	1,440 0 0
Office expense, and contingencies	150 0 0	240 9 0	400 2 0
Miscellaneous and Printing	867 4 0	667 4 0	1,534 8 0
Conference expenses	60 0 0	183 15 0	243 15 0
<i>Deduct</i> —sale proceeds	1,020 11 0	12 0 0	1,032 11 0
TOTAL	1,986 2 0	3,142 12 0	5,128 14 0

STATEMENT D.

Estimate of expenditure of the Indian Railway Conference Association for the financial year 1925-26.

Items.	Actuals for 1923-24.	Sanction for 1924-25.	Estimate for financial year 1925-26.
	Rs. A. P.	Rs. A. P.	Rs. A. P.
Secretary's salary and allowances	32,872 7 0	30,000 0 0	30,000 0 0
Office establishment as per statement E ..	16,098 11 11	16,000 0 0	17,600 0 0
Contingencies	4,027 7 11	5,000 0 0	4,500 0 0
Rent	6,943 7 4	3,600 0 0	5,760 0 0
Printing charges	2,910 9 4	2,000 0 0	2,000 0 0
Conference expenses	375 2 6	1,500 0 0	1,000 0 0
Expenses of the Traffic Committee	1,284 0 11	500 0 0	500 0 0
Essays (Prizes and medals)	200 0 0	1,000 0 0	1,000 0 0
Locomotive and Carriage Superintendents' Committee as per statement F.	5,128 14 0	5,000 0 0	5,000 0 0
Medical attendance	678 14 0	600 0 0	600 0 0
TOTAL	70,519 10 11	65,200 0 0	67,960 0 0
<i>Less credit from Railway Board for Alphabetical List of Stations.</i>	3,000 0 0	3,000 0 0	3,000 0 0
Net total	67,519 10 11	62,200 0 0	64,960 0 0
<i>Add Provident Fund Contribution of Secretariat establishment</i>	3,419 3 0	3,600 0 0	3,940 0 0
TOTAL	70,938 13 11	65,800 0 0	68,900 0 0

STATEMENT E.

Details of Office Establishment.

(See Statement D.)

Clerks, etc.	Rs.	Number.	Amount.
			Rs.
Chief Clerk not exceeding	500	1	0,000
Tariff Clerk not exceeding	300	1	3,600
Clerks not exceeding	140	2	2,784
Clerk not exceeding	100	1	1,050
Clerks not exceeding	85	2	1,560
Clerks not exceeding Rs. 100	61	2	1,256
Peons not exceeding	16	3	552
Office cooly	10	1	120
Chowkidar	10	1	120
Sweeper	10	1	120
Garden staff	35	3	408

STATEMENT F.

Details of expenditure of the Committee of Locomotive and Carriage and Wagon Superintendents.

(See Statement D.)

	Rs.
Secretary and clerk	3,000
Printing and contingencies }	2,000
Conference expenses .. }	
Total	5,000

APPENDIX 'I'.
Railway Provident Fund.

Particulars	DEPOSITS		INTEREST DURING THE YEAR		Total
	Compulsory	Bonus	On Compulsory Deposits	On Bonus	
	Rs.	Rs.	Rs.	Rs.	Rs.
Opening balance including interest on 1st November, 1945	10,65,466	10,19,041	...	...	20,84,507
Estimated Deposits during the intervening period of five months from 1st November 1945 to 31st March 1946	31,600	37,600	15,100	15,000	99,300
Estimated withdrawals during the intervening period of five months from 1st November 1945 to 31st March 1946	21,400	21,000	200	175	42,775
Estimated closing balance on 31st March 1946 ...	10,75,666	10,35,641	14,900	14,825	21,41,032

R. ADIGE,
Finance Secretary.